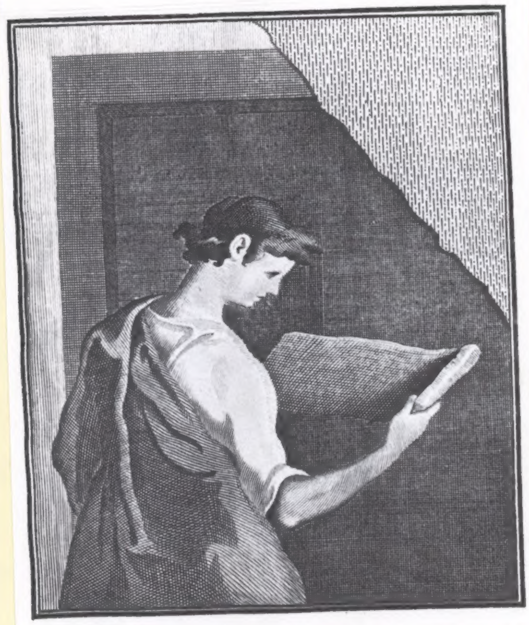

Royal Institute of British Architects.

incorporated in the seventh year of William IV.

Session 1880-81.

I. The Opening Address. By John Whichcord, F.S.A. President.

[Read on Monday, 1st Nov. 1880]

Gentlemen,— It devolves upon me, as your President, to address you on this, the Opening Meeting of another Session, the second year of my term of office, and the forty-seventh in our annals. I do so with some satisfaction because I feel that during the last twelve months a great deal has been done by your Council, and the Committees invited to assist them, towards developing the approved scheme for the Obligatory Examination of candidates for membership — an examination which I venture to think will tend to raise the character of British Architects as a profession, and will ultimately strengthen the Institute as a corporate body. I am

also glad to think that the modified arrangements for conducting the general business of this Session are of a nature likely to be attended with advantage and success. But at the same time I am aware that regrets rather than congratulations are uppermost in the minds of a large number of those who have met to-night for the first time after the annual recess. I am painfully reminded that since our last Meeting I have stood at the graveside of Thomas Henry Wyatt, and reflected then how inadequately I demonstrated, by my presence, the deep feeling of esteem and affection which would have been displayed by his professional brethren, had it been possible to summon them to the funeral – feelings which, I am convinced, were aroused at the sad news of his death, unexpected by all but his relations and a very few friends. For myself, personally, I may now say that the loss of Wyatt is one that cannot be replaced. Since

occupying this honourable position I have sought his advice on many occasions, and I recall with gratification that I always deferred to his mature opinion. It is agreeable for me to remember that the original draft of my Address to you, delivered at the Opening Meeting of last Session – an Address which contained opinions upon important points of professional practice and discipline – was previously submitted to him; and that I accepted unhesitatingly every modification he suggested. Nor were my colleagues on the Council less mindful of the value attached to his experience as a Past President, and his influence as an Honorary Secretary – the latter office being one that he accepted at at a moment when the advice and co-operation which he was able to give, and which he did give, were eminently needed and invariably useful.

Wyatt's connection with the Architects' Benevolent Society was perhaps a principal reason

for his having accepted that office; moreover, he and Benjamin Ferrey, with another still living, were trustees, under a deed drawn in the early days of the Institute, of a sum of money amounting to about £500., which will revert to us for benevolent purposes on the death of a person now of middle age, provided that before then the Institute shall possess a charitable fund for the relief of distressed architects, their widows and orphans. Should no such fund have been established by us the money would revert to another society. Wyatt therefore strongly urged the immediate foundation of such a fund, knowing that, however close may be the present connection of the Architects' Benevolent Society with the Institute, that Society can never be described as having been founded by us as a corporate body. This was accomplished as you will remember a short time ago, and it has

been arranged that the interest of money subscribed by a few Members, and already invested under the title of the Charitable Fund of the Royal Institute of British Architects, shall be administered in accordance with the advice of the Architects Benevolent Society. At the same time the original trustees, appointed under the deed to which I am alluding, were replaced by three new trustees, namely, the eldest sons of Wyatt and Ferrey, and myself.

Following out my promise of last year, notices of deceased Members, both Foreign and British, have been published in the volume just completed of our Transactions, and a brief reference to Wyatt is therein made. Among the notices is one also of Benjamin Ferrey,

whose death occurred during the recess. As you know, he was a Vice-President who bid fair three years ago to become President, but who, in consequence of failing health, was compelled to resign. Ferrey's death severs another link in the chain which connects the present generation with the first Pugin and his remarkable son, Augustus Welby Northmore Pugin. The records of that time, however, are preserved to us in a book which is in itself not the least of Ferrey's many claims to our gratitude and esteem. The loss of Wyatt and Ferrey was preceded by that of another and much younger member. The death of Edward Middleton Barry, a Royal Academician and a Vice-President of the Institute, who would, I

am certain, have been a valuable leader had he lived to fill this chair, is an instance, similar to the case of the late Frederick Cockerell, of calamity to ourselves. Both these comparatively young men were prepared by descent, education and professional reputation to control and advance the destinies of the Institute. They were prematurely and suddenly cut off, and each has left a sorrowing widow with young children to deplore an irreparable loss. Edward Barry's executed works, both public and private, were marked by originality of thought in their conception and care in the treatment of details. The design he submitted in competition for the New Law Courts was an admirable example of scientific arrangement and

economical distribution, and the plan was accorded the first place by the judges. His design submitted in competition with nine other architects for the proposed National Gallery was adjudged the best, and a memorial signed by every one of the competitors was addressed to the Government urging them to entrust the execution of the work to him. As it is, he had the satisfaction of carrying out only a very small portion of his design in the additions and alterations made to the existing building in Trafalgar Square. Looking at the admitted merit of his executed works it cannot be said that Edward Barry was other than a successful man, yet his intimate friends assure me that he

bitterly felt the disappointments which attended an important period of his professional career — disappointments which latterly made a visible effect upon his health.

The vacancy caused in the forty Royal Academicians, by the death of Edward Barry, has been appropriately and worthily filled by the election of Mr Pearson, our Member of Council and the latest recipient of the Queen's Medal. My Address on the occasion of its presentation

expressed, I was led to believe, the sentiments of the general body of Members, by whom, as a matter of fact, Mr. Pearson was recommended to the Queen as the Royal Gold Medallist of the year. But I will take this opportunity of reminding the Institute of its powers, indeed of its obligations in the matter of this medal. I need hardly say that the task of nominating persons to receive the Queen's medal, subject to Her Majesty's gracious sanction, is a most invidious one for the Council. Necessarily some of the best known and most eminent British architects and writers upon architecture are Past Presidents, Past Vice-Presidents, or Members of your Council; to recommend one of them is for the Council to incur the charge of recommending one of themselves. Now the next nomination of some "*architect or man of science . . . . . . who has produced a work tending to promote or facilitate the knowledge of architecture*" for the Queen's gift, will take place on the 14th of March, 1881; and I wish to call your attention to the by-law which authorizes you, quite independently of the Council, to nominate any qualified person you may deem deserving of this distinction. Such action, I am prepared to say, will in no sense be distasteful to the governing body. The mode of procedure is this: Some four weeks before the 14th March next the Council will issue to the general body of Members a Paper, stating the name of the person they recommend for submission to the Queen as the Royal Gold Medallist for the year 1881. A fortnight then remains for you to recommend and nominate some other person; this nomination of yours must be signed by not less than twelve Fellows, and it must be delivered to the Secretaries before the first day of March. It will then remain for the Council either to withdraw their own nominee or submit the two names for election to the general body of Fellows, who, if they do not avail themselves of their powers, relegate the duty of recommending recipients of the Queen's Medal to the Council. In fine, when no nomination is made by you, it is only fair to suppose and imply that the choice of your Council has given satisfaction and is tacitly approved by you.

It may be said that the difficulty of obtaining the signatures of twelve Fellows to the nomination is considerable; but I take it that, should the occasion arise, fifty not twelve signatures would be forthcoming without difficulty. Such a procedure will now be facilitated by arrangements which have recently been made. You will remember that we appointed a Special Committee to consider the best means of improving our Ordinary Meetings and the character of the Papers read and discussed here. The report of that Committee induced the Council to authorize a trial during this Session of certain important modifications. For instance, we shall reduce to a minimum the preliminary business which of late has often taken up more than half an hour, and which I am told has been irreverently called our "parish" business. The ballot for new Members will take place at only four of our fourteen Sessional Meetings, and consequently the reading of new nominations will occur at only four of our Meetings. By this means our Minutes will be considerably reduced. On the nights devoted to the reading of Papers and to Discussions, we shall begin the Paper immediately after the reading of the Minutes, and it will be possible to adjourn Discussions to the subsequent Meeting, when a motion to that effect duly proposed and seconded is carried by a majority of votes. The number of Papers, including my own Addresses, read to you last Session was ten; during the previous one, eleven similar communications were read. This Session, the number will be reduced to six or at most eight, as it is proposed to devote two evenings, namely

one on the 3rd of January and another on the 28th of February, to the consideration of professional questions and of any observations, protests or suggestions relating to the interests of the Institute and the profession, which may emanate from the general body of Members. Thereby the Council hope to be made acquainted with the general wish or expectation, and that the interests of the corporate body may be advanced by a free interchange of opinion on specific subjects. At these Ordinary Meetings for business any subject of professional interest may be brought forward, provided only that due notice be previously given to the Secretaries, for the purpose of announcing it in the Journal of PROCEEDINGS. The Special Meeting for the award of prizes will be held as before, but we have arranged to take the annual election of officers, and of the Board of Examiners under the Metropolitan Building Act, as well as the debate on the report of your Council, during the General Conference of Architects. Fellows from all parts of the country will thus have a further inducement to visit the Institute. Our Dinner, at which I shall have the privilege of presiding, will take place on the previous Friday; our Conversazione will take place on the Thursday following, when my successor will be prepared to receive you. The meetings of the Conference will thus occur at an interesting period of the Session instead of as heretofore at the very fag end of our work; and our final Sessional Meeting will have been held before Whitsuntide, which happens to fall somewhat late. We are also making a slight change in the issue of our publications. As at present the Journal of PROCEEDINGS will be published every Thursday fortnight, between October and June, but it will contain the Presidential and other Addresses at length, abstracts of the Papers read and of the Discussions which follow, reports of the business meetings, and all other matter of current interest. The complete Papers, with notes and appendices, with full reports of Discussions thereon, will form the volume of TRANSACTIONS, which will be issued in the month of September. The object of this annual issue will be apparent to all those who know how much the published work of a Society is beneficially influenced by careful editing; how it is banefully affected by haste and an imperfect or incomplete text. Thereby the publicity of our proceedings will not in any way suffer, for the Institute reports of our meetings will be in the hands of Members throughout the country some hours before those of any of the professional newspapers can reach them.

The fact that the number of our Sessional Papers is reduced to six, or at the outside eight, leads me to express a hope that a better class of Paper than it has been for some years possible to obtain will be offered for the consideration of the Institute. I have strongly urged upon my colleagues the absolute necessity of exercising control over the character and purport of the literary communications made here, and I trust that the three Members of Council who have undertaken the task of reading and reporting upon the Papers presented will fearlessly execute the duty imposed upon them. I have only to add my conviction in reference to this matter that, within our ranks both honorary and professional, there is more than enough of genius to provide us with suitable Papers of interest and value; and it will be seen, on glancing back through our volumes, that some of the best Papers read here have been communicated by young and comparatively unknown men, who have since obtained some professional position. I would not, however, have it supposed that the purpose of the Institute is confined to the mere writing, reading and discussion of professional communications, nor would I admit for an instant that its use is impaired because only a small minority of members attend these Meetings.

Many things combine at the present hour to diminish interest in the work done at them; the world is overburdened with Papers, Letters, Lectures, Discussions, and no small part of the load is sustained by this country. To carry on, at the recognized head-quarters of our profession, official duties affecting our interests as a corporate body; to promote and facilitate uniformity of professional practice; to secure, as far as possible, integrity of practice; to consolidate step by step the foundations already laid of that Examination which I think will raise the character of an architect in public opinion, and debar unfit and ill-educated persons from the profitable exercise of our calling, whereby at the present moment incalculable prejudice is caused to the worthier members of a noble profession—these form silent and efficacious work done by the Council and Committees.

The general scheme of that Examination was tacitly approved by you at the Annual Meeting in May last; and it has since been worked out in detail by the Architectural Examination Committee. After nine sittings this Committee presented an excellent Report which, with a few principally verbal amendments, has been adopted by the Council. It has consequently been proposed to devote our Ordinary Meeting for business, which occurs on the 3rd of January next, to this matter, in order that the general body of Members may be afforded an opportunity of discussing the scheme—the pressure of business at the last Annual Meeting having rendered any such discussion impossible. For this purpose, the regulations and programme of the Examination under By-law XIV., as drawn up by the Committee and approved by the Council, will be printed in the Journal of PROCEEDINGS, and thereby every Member will be enabled to make himself acquainted with them before the Meeting in January. Meanwhile, we have taken the necessary steps to form a Board of Examiners, and to obtain such a modification of the terms of the Ashpitel Prize as will permit the prize to be awarded annually to that candidate who, of all those examined during the year, distinguishes himself most creditably in the Examination. We have also decided to limit the Voluntary Examination, to be held in June next, to four days instead of six days as in previous years, but of this you have already been informed by the programme which was published some ten days ago. This, the twelfth that will have been held since their establishment, will be the final and concluding examination of a voluntary character. It consists of two sections: Artistic and Scientific. At the previous Examinations a candidate has been permitted to pass one year in one section and another year in the other section. There are consequently a few gentlemen who, having passed in only one section, are not yet entitled to the usual certificate, and in order to qualify for it they must present themselves next June and pass in the other section; but all new candidates at the June Examination will be required to pass in both sections. We shall thus be prepared to take our thirteenth Examination—the first under By-law XIV.—in the month of March, 1882.

I may perhaps be permitted to revert to what I said on this subject in my Address of last year. I asked whether the character of such an Obligatory Examination as we proposed should be general or strictly professional; I am glad that it is recommended to be one in reference to professional study and practice only. I said that the real difficulty lay in deciding upon the artistic capacity of a candidate; I am glad to know that the difficulty is reduced to a minimum. I maintained that, in my opinion, both geometrical and free-hand drawing were essential requirements for an architect; I am glad to know that not only does the programme of the

proposed Examination include practical tests of such requirements, but the probationary work required in the first instance from each candidate is likely to afford a very feasible means of testing a candidate's natural aptitude for the arts of invention and design. I maintained that an architect should be cognizant not only of the principles of construction,* but of the nature, qualities and value of building materials;* and I am glad to know that it is proposed to devote an entire day to examination in such subjects. In fine, I have gone carefully through the suggested regulations and programme, which embrace requirements such as, I submit, every person seeking to be an architect should possess. Nor do I see in their general tenour anything Utopian, or indeed anything which might deter the heaven-born artist—if artistic genius be purely and really a celestial gift—from seeking admission to the Institute through the medium of an Examination such as that we have decided upon recommending for final approval.

And here, Gentlemen, I am induced to quote a passage from an Address delivered from this Chair by the first professional President who ever sat in it. I mean Charles Robert Cockerell. He was a man who, as the most artistic architect of the present day will admit, was, if anything, an artist. His words, uttered more than twenty years ago, when the graphic side of architecture was less understood and less followed than it is at present, merit your immediate attention. "*So rare and difficult,*" said he, "*is the union of the scientific and the graphic departments of this art in the same person that theoretic writers are at variance as to the preference to be given to the one or the other faculty. Thus the learned Rondelet defines architecture as 'a science, the object of which is to direct the operations of every sort of building, so as to unite convenience, solidity and beauty of forms . . . . a vast science, the purpose of which is to provide for the security, the convenience and the magnificence of nations; and to give them that lustre and prosperity which true civilization implies. Most modern architects are rather decorators than constructors, aiming, like the painter and sculptor, chiefly to please—indulging in captivating but often impracticable designs, induced by their associations with the imaginative arts of painting and sculpture, and . . . . attracted by splendour and ostentation rather than by the graver merits of solidity, convenience and durability.'*" Now it is not I that am quoting a theoretic writer, it is the late Professor Cockerell who speaks, and who makes a pertinent quotation from a great Frenchman, the learned Rondelet—that Rondelet who, at the very beginning of this century, described the architect of his day as a decorator rather than a constructor. Are we quite convinced in our own minds that Rondelet, if he lived at the present time, would define an architect in language more palatable to our own sense of what he should be? Are we quite sure that the cry for art, more art, in which I admit this country was long deficient, has actually provided us with what we required? Has not the tendency in England of late years been to unduly exalt the art at the expense of the

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* Under the head of "Materials and Construction," in the programme of the Examination under By-law XIV., as recommended for final approval, are comprised the following:—

(1) The nature and properties of Building Materials, including their decay, preservation, quality and strength, and their application in building.

(2) The principles of construction, as applied in practice to foundations, walls, arches, vaults, roofs, floors and partitions.

(3) Drainage, sanitary arrangements and requirements.

(4) The application of formulas for calculating the strength of materials.

(5) Shoring and underpinning, and dealing with dangerous and ruinous structures.

science of architecture? so that architectural science is gradually becoming the speciality of men who are not and who do not pretend to be architects. The construction of aqueducts, roads, terraces, gardens, fortresses, bridges, seaports, viaducts, was once and still lies within the domain of architecture; yet few in England think of employing an architect on such works. In France, the best Parisian architects still think it within their province to collate evidence on the building legislative enactments of their country, and advise upon such subjects; here in this island there is a growing tendency to leave matters connected with building legislation to surveyors. In France, the planning of new thoroughfares, the laying out of public places, the daily charge of architectural monuments, the care of great estates both public and private, is retained by qualified members of our profession; here in England such duties are often relegated to all sorts of persons. I assert without hesitation that local governments and municipalities, indeed many great owners of the soil, prefer to be advised by men who ostentatiously discard connexion with the picturesque and artistic elements of professional practice. We are more or less to blame for this state of things. Though thirty years ago there was plausibility in the successful efforts to stimulate the pursuit of architecture as an art, the necessity for such stimulus has now in some measure ceased, and the object of all thoughtful practitioners should be to reclaim much *bonâ-fide* practice diverted from its legitimate course—to foster in younger men a regard for that scientific learning and mental excellence which Philibert Delorme preached, and which our own Sir Christopher Wren demonstrated to be worthy the pursuit of an artist.

But however limited may be the modern architect's connexion with the laying out of cities, or even the design of new thoroughfares in this Capital, he at least is afforded a doubtful satisfaction in viewing the disastrous efforts of others to accomplish work, the design of which would, in earlier days, have been entrusted to men of our profession. I am of course aware of the difficulties which beset all attempts at metropolitan improvements—of the many legal and legalized impediments to public progress—but I doubt whether the course pursued by the authorities, in facing those difficulties and removing those impediments, is either profitable or judicious. Take the west end of London, where the proposed line of new thoroughfares long-promised may be traced by half-demolished houses, empty tenements and vacant plots of ground; and enquire whether these proposed thoroughfares are being executed in accordance with any well-considered architectural plan? There is little likelihood that the generation which is paying for them will enjoy the entire fruits of the enterprise. True, as mere thoroughfares, they may yet be made use of by living men, even of mature age; but that anything short of a miracle of accidents will render them things of beauty, or worthy of a great Capital, I am constrained to doubt. Part of the system adopted, if system it may be called, is to connect a series of existing streets by removing blocks of old houses which divide them; by pulling down one side only of such existing streets, and driving the new thoroughfare along a necessarily tortuous and irregular line—a line formed by the untouched sides of streets, often of miserable dwellings originally erected without regard to either convenience or salubrity. Such is the mode in which the new street connecting Oxford Street and Old Street has been made; such is the mode in which the purlieus of Soho are about to be penetrated with the intention of opening important thoroughfares, and I believe emphatically that this mode is dictated by financial necessity. The result will be, I venture to think, that,

for thirty and more years after the roadway of these new thoroughfares is completed, or at least until existing terms of leases fall in, there will remain on one side of the way an irregular line of disjointed blocks, huge and lofty; on the other side of the way rows of old and dingy tenements, with here and there a new building raised in the air over its squalid neighbours, and acquiring in due course prescriptive rights over the land on which such neighbours rest. Moreover, the squalid neighbours themselves, already possessing powers acquired by similar prescriptive rights, are likely in skilful hands to be fertile of obstruction to individual improvement and public embellishment.

It must be admitted that the position of the Metropolitan Board of Works is one of unexampled difficulty. If even the powers vested in that body to effect improvements adequate to the scientific and artistic wants of the age were sufficiently broad, and if that system of liberal expenditure by which alone a satisfactory return is to be obtained were sufficiently understood; if even public opinion were educated enough to afford proper encouragement to the scientific re-arrangement of public places and streets in London, there would still remain the opposing complications and entanglements connected with vested interests and abuses of the law of property. The systematic and organized obstruction which speculates upon the chances of exorbitant compensation would still issue triumphant from every fresh adventure. Moreover, there would still be found wanting, in metropolitan administration, that initiative faculty, that directing power which sees, suggests and plans the needed improvement—the deficiency of which during recent years has been painfully conspicuous. Too much in England is left to chance and the happy-go-lucky encounter of conflicting interests, both personal and pecuniary. Take a recent case in the City of London, I mean the much needed completion of the inner circle underground railway. There were the two railway companies, the Corporation of London, the Metropolitan Board of Works, the various landowners and leaseholders,—all interested, but all at fault for a leader in a scheme of improvement which all admitted to be necessary. The probable cost of connecting the Aldgate Station of the Metropolitan Railway with the Mansion House Station of the District Railway has been shown to be so enormous, in consequence of the value of land and tenements in the neighbourhood, that the two railway companies dare not undertake the responsibility. It had been confidently expected that the Corporation and the Metropolitan Board would have co-operated in the scheme for the completion of the inner circle railway, as it included the construction of a wide handsome street in continuation of Cannon Street to Trinity Square. This proposed street would have given a great arterial thoroughfare in a crowded and almost impenetrable part of the City, and would have provided sites for blocks of offices and commercial buildings for which there has long been considerable demand in the locality. But neither the new street nor the completion of the inner circle railway is yet a fact, though the postponement that has taken place is not due to any structural or indeed any difficulty of an insuperable nature. It is due solely to the difficulty of apportioning a just rate of contribution by the various parties interested to meet the enormous outlay involved. The railway companies finding the cost of the land necessary to make their railway in the ordinary way would be a bar to any possibility of profit, unless the Corporation and the Metropolitan Board would undertake simultaneously the construction of a new street and incur the burden of the cost of the same, sought powers to burrow under the soil. The object of this was to avoid the

obligation of constructing a new street over the railway. The companies offered to make compensation only for damage, without the necessity of acquiring the entire freehold of all the property touched by them. The Bill by which it was attempted to obtain such powers was as might be expected thrown out by the House of Commons. It, therefore, still rests with the two railway companies and the two great governing bodies of London to make arrangements in respect to the cost of the superstructure—that is, the new street and the new building sites—so that the whole matter may be presented to the coming Session of Parliament in a form which will enable a great and an absolutely essential public improvement to be commenced.

The educational part taken by the Institute in Metropolitan business for the last 25 years, under the provisions of the Building Act, has recently been the subject of a communication from us to the Metropolitan Board of Works. The Council, acting on the advice of our Board of Examiners appointed by you, have taken steps to improve the character of the Examination for Certificates of Competency to hold the office of District Surveyor in London. Instead of one sitting of four hours for the Written Examination there are now two sittings of three hours each, and in the latter of these the candidate's skill in making working drawings is tested. An Oral Examination remains as before. We have also, after consultation with the Metropolitan Board, determined to impose a fee on each candidate for examination—a rule which will take effect at the beginning of next year.

The modern system of Examination at home is closely allied to the extending fashion of International Exhibitions abroad; cousins at the Antipodes are returning the compliment which this country was the first to pay to colonial and foreign enterprise. The awards recently made to British Architects at the Australian International Exhibition held this year at Sydney are numerous; I am indebted to Mr. Charles Barry for a book containing a list of these awards, and which is on the table for the inspection of all present. No official intimation has yet been made to the Institute on the subject of the architectural drawings exhibited at Sydney—work with which we were immediately connected. I trust, however, that when this same Exhibition is resumed next year at Melbourne my successor will be enabled in due course to afford Members fuller information about it than at present lies in my power respecting the Sydney gathering. The preservation of such official Reports as the one to which I have alluded is part of the many functions of our corporate existence, and our Library ought to contain all records of facts relating to British Architects throughout the world.

The slight use made by Members of our valuable Library has been more than once touched upon by my predecessors, and I have sometimes asked myself whether its usefulness might not be extended, and the purposes for which it has been collected might not be advanced, by throwing it open to all *bonâ-fide* students of architecture. That this can be done without trenching upon the privileges of Members is evident, for no one under the age of twenty-one can become an Associate, and practically very few gentlemen who are less than twenty-five years old offer themselves for Associateship. It therefore affords me great satisfaction to state that steps have been taken to open the Library free to young men under twenty-three years of age, who are engaged in the study or even practice of architecture, and who produce satisfactory evidence of the fact. The legacy of £100. bequeathed to the Library by Thomas Henry Wyatt is another instance of our deceased friend's goodwill and devotion to the Institute. A recent donation, made through the good offices of Professor Donaldson, of

several original drawings by the late Owen Jones, whose portrait adorns this room, is no less welcome; this donation has been made by the two Misses Jones, sisters of our late esteemed colleague. I am further informed by Professor Donaldson that it is the intention of these two ladies to bequeath to the Institute such a sum of money as will found a Studentship of the value of £50. per annum, to be tenable for two years, for the purpose of assisting meritorious students to travel, in order to advance their knowledge of architecture and of colour applied to architecture. We shall consequently one day possess an Owen Jones Studentship—one that will probably be not less popular among students than the medals and prizes we annually offer in connection with the names of Soane, Pugin, Tite, Ashpitel and others. Thus, slowly and surely, the promise of our Founders is being fulfilled; and it may yet, perhaps at no distant period, become the pleasurable duty of some one in this Chair to expatiate upon what has been effected, in your name, "*for the general advancement of Civil Architecture*," to quote our Charter, "*and for promoting and facilitating the acquirement of the knowledge of the various Arts and Sciences connected therewith.*"

It does not, however, come within the powers of the Council to do all that many well-intentioned practitioners think ought to be done. I have heard it seriously maintained that the only use of the Institute of Architects is to enforce observance of a uniform tariff of 5 per cent. commission to be charged by old and young, experienced and inexperienced, capable and incapable practitioners of architecture; and that nothing short of expulsion under the By-laws should await the youthful or diffident practitioner who places upon the value of his professional services a lower figure than that charged by his elder or more fortunate brethren. I cannot conceive anything more illogical or more suicidal. The clauses in the Institute Paper, entitled the "Professional Practice and Charges of Architects," represent simply the custom of the profession in Great Britain and Ireland, in India and the British Colonies. Where doubts crop up as to the amount of charges due, where no previous agreement has been made and disputes occur, where death intervenes, when a Court of Law asks for information as to the custom of the profession—then the Paper of Professional Practice and Charges is rightly and necessarily cited. But no man in signing the declaration of a Fellow or an Associate of the Institute, and in accepting the terms of our Charter and By-laws, incurs the obligation to abide by any restraints of professional charges. All such commercial and professional restraints are opposed in more ways than one to the laws of the realm; and would, at the best, encourage action on our part not dissimilar of its kind to that of ill-advised trade-unionists. I admit that there are questions of professional practice requiring a great deal of thoughtful consideration—questions which may very fitly be discussed this Session—particularly the complications connected with the taking out of Quantities, and the best means of obtaining a fairer adjudication in Architectural Competitions than appears to exist. These are matters that should occupy the serious attention of the Conference to be convened in May next, when I trust that a large number of those architects who signed the Memorial on Competitions will do us the favour to be present. I also hope that the numerous Quantity Surveyors now practising in London and some provincial cities will afford us assistance in the discussion of several important points which are likely to be raised on the subject of Quantities: the division of labour connected with them and the present mode of paying for them.

Perhaps nothing about the Memorial on the subject of Competitions, presented to the Council by Mr. Street, afforded me more astonishment than the fact that there are in the United Kingdom more than 1300 professional architects, for at the present moment the Fellows and Associates of the Institute together only reach a total of 716. Indeed at the close of the last Session the numbers stood thus :—

	F.	A.		F.	A.
Australia - - - - - - -	4	2	Ireland - - - - - - -	6	3
Colonies and abroad - - - -	4	12	London and Suburbs - - - -	209	253
English Counties - - - - -	110	82	Scotland - - - - - - -	15	4
Indian Empire - - - - -	3	3	Wales - - - - - - - -	0	6

But I am still more astonished to find from a comprehensive and useful list, printed in the advertizement sheets of the *British Architect* newspaper, that in this island alone there are nearly 3000 persons professing to be engaged in the practice under some form or other of architecture. It is there stated that in Birmingham there are 49 architects, of whom only 7 are Members of the Institute; in Bradford there are 22, of whom 2 are Members; in Bristol 25, of whom 4 are Members; in Edinburgh 41, of whom 3 are Members; in Glasgow 60, of whom 12 are Members; in Liverpool 57, of whom 13 are Members; in Manchester 113, of whom 20 are Members; in Sheffield 31, of whom 7 are Members; in Wolverhampton 11, of whom 1 is a Member; in York 10, of whom one is a Member; in London and suburbs more than 750, of whom only 462 are Members. The cathedral towns of Chester, Lichfield, Lincoln, Peterborough, Ripon, Salisbury, are not represented in our ranks by a single Fellow or Associate. In Hull, Sunderland and Wolverhampton, which contain together it is said 38 architects, and in the principality of Wales which also is said to contain 38 architects, there does not reside even one who has formally accepted the obligations of a Fellow of the Institute. Now I know of course that a vast number of the gentlemen whose names are put down in Directories as architects, and who are so called by their neighbours, could not and ought not to become Members of our body. But when you consider that of the many memorialists on the subject of competitions less than a third are Members of the Institute; when you look at the long array of architects' names printed in the last issued number of our Journal of PROCEEDINGS—architects who have memorialized the Council and who are not Members of the Institute—the very pertinent question arises: For what reason do these practitioners stand aloof from the corporate body of the profession? Are they unable or do they fear to incur the obligations which we have accepted? Some no doubt are prevented from entering our ranks by the expense, slight as it is of so doing; a few others perhaps by caprice. But that the majority are ostracized in consequence of conscientious reasons, I cannot for one moment suppose; nor do I think that there is anything in the declaration of a Fellow or of an Associate, or anything in our Charter and By-laws, which an honourable practitioner, having at heart the good of his profession and of himself, ought to refuse to accept. Indeed it is only due to the public as well as to ourselves to direct serious attention to the number of architectural practitioners who submit to no recognized professional discipline—who take no obligation designed to secure integrity of practice and eliminate all pecuniary interest in building materials or participation in the commerce of building. Their name is Legion. It is only my duty as your President to state advisedly that the published names of architectural practitioners in this island alone exceed by at least 2000 those on the roll of the corporate body. I shall doubtless be reminded that those of them who are members of local

societies do accept obligations and do combine to resist evils and abuses which, at the very formation of the Institute, it was the object of our founders to root out, and which they largely succeeded in abolishing. But I need no such reminder. I am aware that the constitution of two or three of the provincial Institutes and Associations does not seriously differ from the purport of our own; but are such societies endowed with the powers which the corporate body of British Architects possesses? I doubt it. I venture to maintain that the interests of the public not less than of the honourable practitioner of architecture are linked with the prosperity and influence of the Royal Institute of British Architects; such interests are linked with the legitimate control the Institute exercises over the conduct of those who accept the systematic discipline it is authorized to impose.

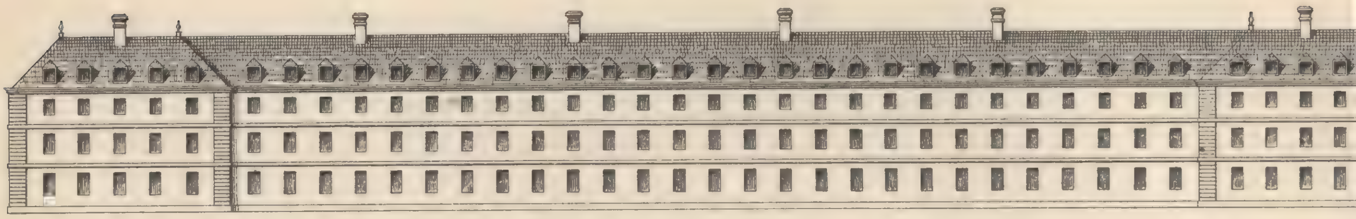
CHARLES BARRY, F.S.A., *Past President.*—Gentlemen, I was only asked five minutes before entering this room to be the means of conveying to the President the thanks which I am sure you will freely accord to him for his most useful Address. It has been one of an eminently business-like character, and will, I have very little doubt, lead to useful results, professional, social and personal. As I have said, it is a practical Paper, relating to professional questions which interest us all, rather than one of those abstract Addresses which have been often delivered in this room, not, I hope without their having produced useful and good effects, but not as in the present case entering into minute details of the work which, in the past year, has occupied the Council. The President has lucidly explained a number of measures, or experiments as he very properly calls them, which are proposed with your sanction to be tried during the coming year. I need hardly assure you that they have received very anxious thought on the part of the Council, whose sole and only wish has been duly to represent the views which they believe the majority of the Members hold, and to be the means of giving effect to those views. The compulsory examination which was alluded to is a most important experiment, if not *the* most important that has ever been attempted by the Institute. The President is very sanguine of the great good it will be to the public, and of the still greater good it will be to ourselves. I am sure we all join in his hope; I trust that it really may be so, but it is a very great experiment, and we must not be unprepared for a certain measure of ill-success or partial success in its earliest days. It has been carefully thought out by the Council, carefully debated and discussed, and has received undoubtedly the approval of a large majority of the members. That will be a reason, as I hope, for not being faint-hearted if it does not succeed all at once, or if the obvious success is not quite immediate; it will be a reason rather to persevere with it. The next subject to which the President referred comes home to us very much indeed. It is the realization in this year, in consequence of an unexpected stimulus, of a desire which has long been expressed and has been felt essential: that we, like many other bodies of similar social and professional character, should have a Charitable Fund, from which relief, after due inquiry, could be made to those among us who are not so fortunate as others; and that fund has been started with some few subscriptions. A personal matter was alluded to by the President: amongst those Members whose loss he deplored, in kindly and feeling language, there was one of whom I cannot speak without the deepest emotion. All I can here do is to thank him for the way in which he alluded to my lost brother, and to feel that his sympathy and that of other friends is all that is left to the deeply bereaved. The sympathy so expressed will be most

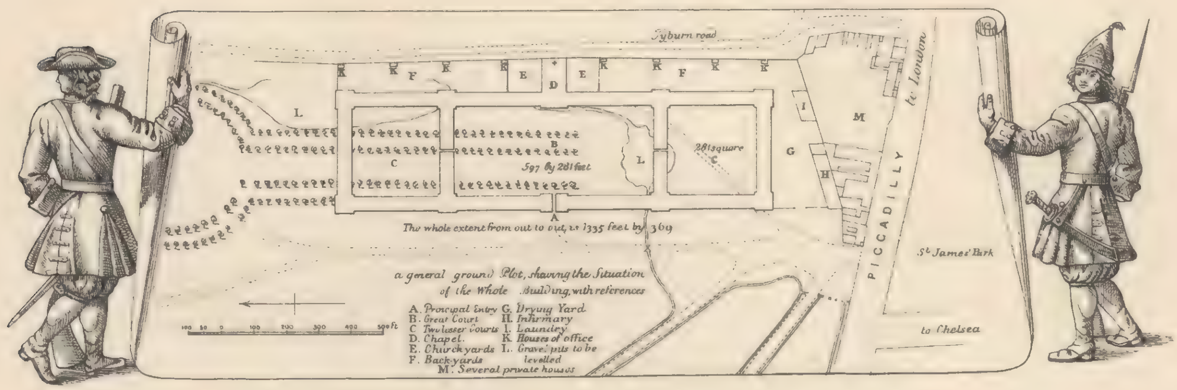
gratefully appreciated by those most near and dear to the late Edward Barry. The President then touched upon the experimental idea of reducing our number of Papers, while expressing a hope that their value might increase, and upon having a certain number of Business Meetings for the discussion of professional subjects. The latter may be the means of great good; I need hardly point out to you that they may also be the means of great mischief. The Council hope that they may be attended with good only, and that the Members, being invited to discuss questions which have great professional interest, but which must at times necessarily have a personal application, will approach such discussions with calmness, temper, and a due sense of the responsibility which any one will incur who brings forward, or who discusses, subjects of this sort. One advantage of course will be that from time to time the hands of the Council will be strengthened, and their responsibility in dealing with professional questions will be lightened and helped; they will be relieved thereby of a certain amount of that responsibility which has been hitherto alone their burden, although I am bound to say that that burden and responsibility have not always been quite fully appreciated. The President touched upon a very large question, namely, the proportion which science and art should bear to one another in the studies of a young architect, a very large question, one of those most difficult to discuss, and it would of course be quite out of place to attempt to do so now. The only remark that occurs to me is with reference to the interesting extract from an Address of the late Professor Cockerell, who in his turn quoted Rondelet. May I remind him and you that they both referred to a time now passed away. Events come and grow very quickly; customs, habits, modes of thought and requirements change, education advances and has advanced largely, and that proportion of science and art in education, which both the Professor and Rondelet so much desired, is invariably attempted to be attained in every examination, and in every form of professional education, of the present day. Then the President referred to the subject of public improvements, and I entirely concur, as we must all do, in the criticism he made as to the inception and mode of executing those improvements. They are lamentable failures in the æsthetic point of view; they are only a partial success even in the more commonplace object of connecting thoroughfares. I confess that I for one am quite hopeless of a better system soon prevailing in this country. It may be that continual droppings, from such Addresses as the President has given us, and from professional opinions often expressed, may wear away the stone of obstruction to that progress which we desire for London, and to that beauty which we desire for it; though we shall never, I fear, live to see it. But nevertheless the President for all that is right in alluding to the present unsatisfactory state of things, and everybody is right in denouncing it, in order that some protest may remain on record for the assistance of those who come after us, and that they may be able to feel that they are not striving against a difficulty which others have not endeavoured to remove. The next question the President touched on was that of professional remuneration and the Institute scale of charges. I am afraid I cannot quite agree with him in what he had to say on this subject. I do not think anybody who has studied our Paper of Charges can say it too highly rewards, in any one of its clauses, the thought, difficulty and labour attached to the performance of the duties referred to. There is no reason whatever, I think, for reducing its charges even to the youngest amongst us on whom responsibility is laid. There may be reason for the elder and more experienced practitioner to

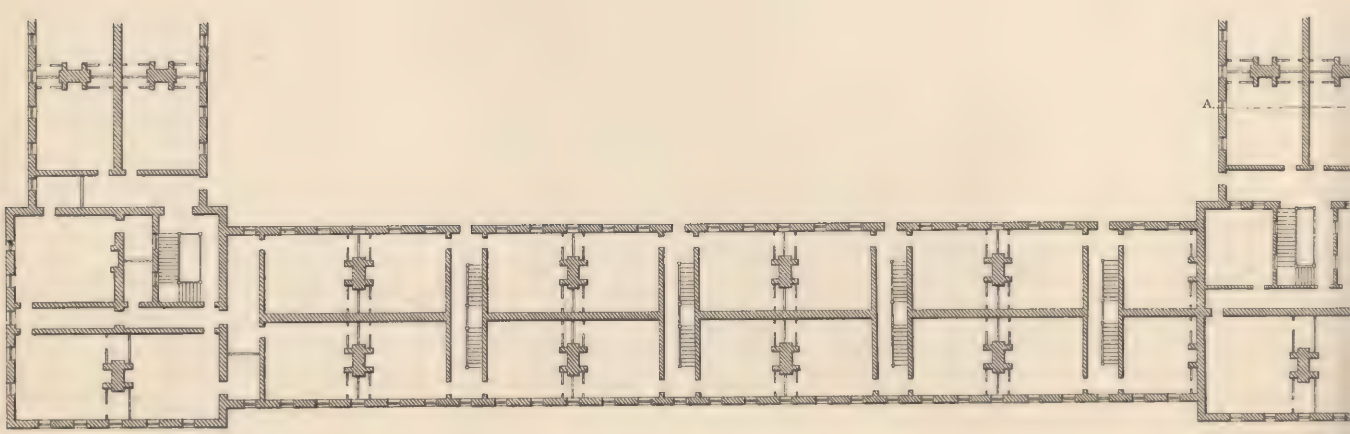
require more than the remuneration therein set down. The object, as I take it, of that Paper was to endeavour to secure something like uniformity of practice; and while the man the most able can practically obtain at least his 5 per cent. under its sanction, or a higher rate in special cases, the younger members are also enabled to obtain a recognition of 5 per cent. for their labour. They are thus prevented from being put in the position in which they might very naturally and probably be sometimes put, by employers trying to beat them down, if the rules of remuneration were variable—by putting one against another, whether he would take 4½, or 4, or 3½, or 3 per cent., and so induce a spirit of contention between them, which is earnestly to be deplored. Gentlemen, I will only conclude these observations, which I very inadequately place before you, by asking you to join with me in paying that tribute to the President, which he so thoroughly deserves not alone for preparing his Address, although I know by past experience what labour that involves, but for his unfailing assiduity during the whole of the past year in the discharge of the multifarious duties belonging to the position in which you have placed him. The realization of the past gives absolute hope and promise of the future, and I venture to think that the remainder of his term of office will be no less usefully employed, and no less devotedly given to your interests and the interests of the whole profession, than has been the case hitherto.

CHARLES L. EASTLAKE, *Fellow.*—Gentlemen, as a former officer of the Institute, I have great pleasure in seconding the vote of thanks to our President for his excellent Address. The number of subjects to which he has alluded make it difficult for me at this hour of the evening to refer to them individually, but no one can help recognizing their importance, or confessing Mr. Whichcord's skill and tact in treating the various matters to which he has called attention. The different modifications which he has announced, relating to what may be called the internal economy of the Institute, seem to be eminently practical and likely to be of benefit to the profession at large; while his remarks on other subjects are characterized by that sound sense and acute judgment which have tended no less than his professional attainments to place him in the Chair. If I venture to select one subject more than another, it would be the President's touching allusion to the loss which the Institute has sustained through the death of our lamented colleagues, Thomas Henry Wyatt, Edward Barry and Benjamin Ferrey, all personal friends with whom I was officially associated here for many years, and for whom I have always entertained the very highest respect. In conclusion, let me congratulate the Institute on the recent acts of generosity which have placed at its disposal gifts tending to develop the rising taste for architecture in this country. I cordially echo the wish expressed by our President that the large proportion of architects who, from accidental and various reasons, have held aloof from this guild will speedily join it, and thus contribute in maintaining that brotherly and friendly union which, in my opinion and I believe in the opinion of most of those who hear me, has tended and will tend to uphold the honour and dignity of our profession.

THE MODERN BARRACK, ITS PLAN AND CONSTRUCTION, (Nº I.)

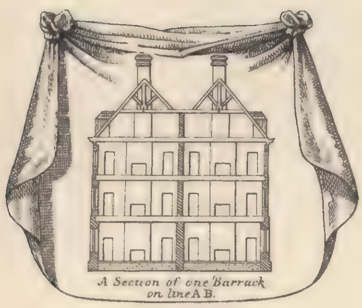


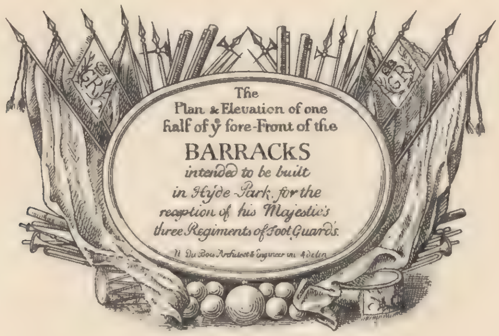


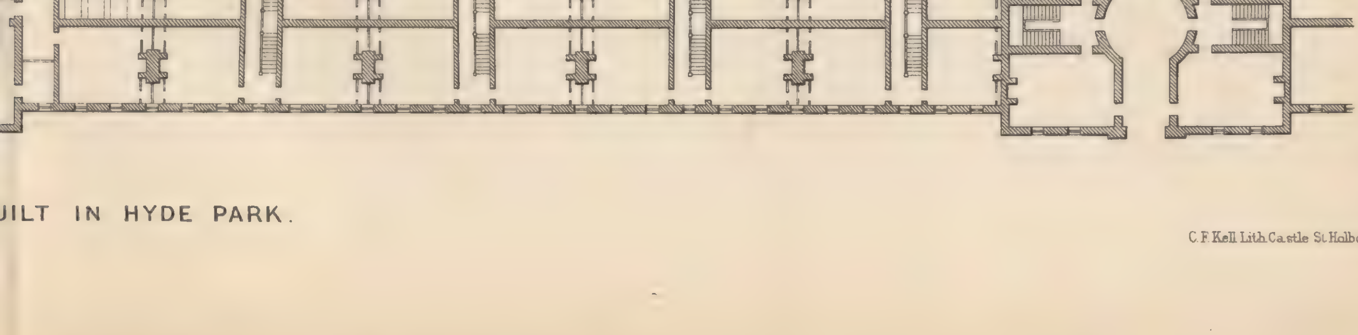


BARRACKS PROPOSED TO BE

Circa 17







UILT IN HYDE PARK.

C. F. Kell Lith. Castle St. Holborn, London E.C

II. THE MODERN BARRACK: ITS PLAN AND CONSTRUCTION.

By E. Ingress Bell, *Associate.*

[Read on Monday, 15th November, 1880, T. Hayter Lewis, F.S.A., *Vice-President*, in the Chair.]

IN conformity with the recommendations of a Royal Commission on the Re-organization of the Army, the *Military Forces Localization Act*, 1872, provided for building barracks and otherwise effecting the localization of the military forces of this kingdom.* An essential feature of the new system was a re-distribution of the Home Forces, and the permanent identification of particular regiments with particular localities. To carry this into effect the establishment of a number of Barrack Centres, or Brigade Depôts, was necessary; since the passing of the Act, and under its powers, new barracks have accordingly been built or increased at 54 different stations in the United Kingdom, accommodating a total force of 12,000 men, and costing, with all the various accessory buildings incident to a modern barrack establishment, no less a sum than £2,500,000, exclusive of the land upon which they stand.

About one hundred years ago barracks were built throughout the land in similar numbers, under circumstances which I shall briefly recount; and we are thus provided with a standard by which to gauge the progress of a century in the matter of barrack planning and design. It occurred to me that the subject would not be altogether without interest to the Members of the Institute; and having received the ready assent of the Secretary of State for War, together with the loan of a large number of drawings, I propose to lay before the Members certain particulars in connection therewith.

It must be apparent to anyone who will give a moment's thought to the matter that, until a very recent period, our barracks were, as a class, almost the only buildings in the kingdom which had no pretensions to architectural character. Our workhouses and prisons,

* [35 & 36 Vict.] *Military Forces Localization* (*Expenses*). [Ch. 68.] An Act to make provision for defraying the Expenses of building Barracks and otherwise providing for the Localization of the Military Forces. [10th August, 1872].—Most Gracious Sovereign, We, your Majesty's most dutiful and loyal subjects, the Commons of the United Kingdom of Great Britian and Ireland, in Parliament assembled, being desirous to provide for the building barracks and otherwise effecting the localization of the military forces of this kingdom, have cheerfully granted to Your Majesty the sum of three million five hundred thousand pounds, to be paid out of the Consolidated Fund towards defraying the expenses to be incurred in carrying into effect the several purposes relating to the building barracks and otherwise localizing the military forces specified in the schedule annexed hereto, &c. &c.

SCHEDULE REFERRED TO IN THIS ACT.

HEADS OF PROPOSED EXPENDITURE.

	£	£
1. Provision of depôt centres .	1,297,200	1,627,200
Provision of depôt storehouses	330,000	
2. Training barracks for militia (also available for regular troops)	255,680	1,010,480
Barrack accommodation to replace accommodation taken for depôt centres	754,800	
3. District store establishments		100,000
4. Purchase of land, &c. :—		
At depôt centres . . .	204,000	554,000
For a metropolitan exercising ground	50,000	
For a tactical training station	300,000	
5. Contingent expenses		208,320
Total		£3,500,000

even, were works of art by comparison; with a solitary exception or two,* our English barracks were hideously and uniformly ugly. But, what is of even more importance, they were as defective in plan as in design, and the reasons for their unsatisfactory condition, in both respects, may be stated in a few words. There is, perhaps, no point in our national history for the past two hundred years and more which one meets with more frequently, or which stands out more prominently, than an inveterate antipathy to the establishment of a standing army—an antipathy which was shared by all classes of the community, and which in a measure survives, even to our own day, in the security for our liberties which the *annual* vote for the army provides. The British army as a permanent force dates only from the Restoration, when, in the Act for disbanding the troops, an exception was made in favour of guards and garrisons. The total force did not exceed 3000 men. The garrisons were for the defence of fortresses, such as the Tower, Portsmouth, &c.; the guards were for the protection of the person of the sovereign.

The first barrack proper was, therefore, that built for the accommodation of "His Majesty's Horse and Foot Guards," at the Palace at Whitehall. It occupied a portion of the site of the present Horse Guards; and the Commander-in-Chief now appropriately holds his levees on the spot where the British army was, so to speak, born. The picturesque aspect of the original structure is familiar to us from the numerous prints of the time. I am able, through the courtesy of my friend Mr. Tregellas, to present to the Institute Library a copy of a very interesting historical chart, prepared by him, showing the Horse Guards in its various stages from its commencement to the present time, and compiled from documents many of which are not accessible to the general public.

The Force thus legally established and limited, was, notwithstanding the public sentiment and Parliamentary opposition, steadily increased; but no barracks were built for its reception. The Royal income could not support, and Parliament would not vote, the cost. Consequently the troops were either kept permanently under canvass, or billeted upon the community. In the one case the troops suffered, in the other the public. In 1704 the garrison at Portsmouth lost one half of its strength in eighteen months; and in 1707 the "*ill condition*" of two regiments in the Isle of Wight, "*from their long encampment there,*" called forth an order for hiring empty barns, "*whereby the soldiers might be kept from perishing through the severity of the weather.*" The billeting of the troops was so burdensome that, in 1793, even the Sussex publicans in a body threw up their licenses, and pulled down their signs, on the approach of the army. Mr. Pulteney, in the House of Commons, employed the admitted evils of the system as an argument for its continuance. "*If,*" he said, "*the soldiers were kept in barracks the people would be insensible of their numbers, and might not think of reducing them till the army was strong enough to support itself against the law.*" The predominant apprehension was that, in the language of Macaulay, the army might become, what it is in the nature of armies to become, what so many armies have become—what the army of the Roman Republic became, what the army of the French Republic became, an instrument of despotism—that the soldiers might forget that they were also citizens, and might be ready to serve their General against their country. These apprehensions may seem exaggerated and irrational to us—living in happier times, and under a more settled form of government—but they were not only really felt by our

* The barracks at Winchester were originally built, as a palace for the King, by Sir C. Wren. They were converted into a barrack in 1796.

THE MODERN BARRACK, ITS PLAN AND CONSTRUCTION, (Nº 2.)

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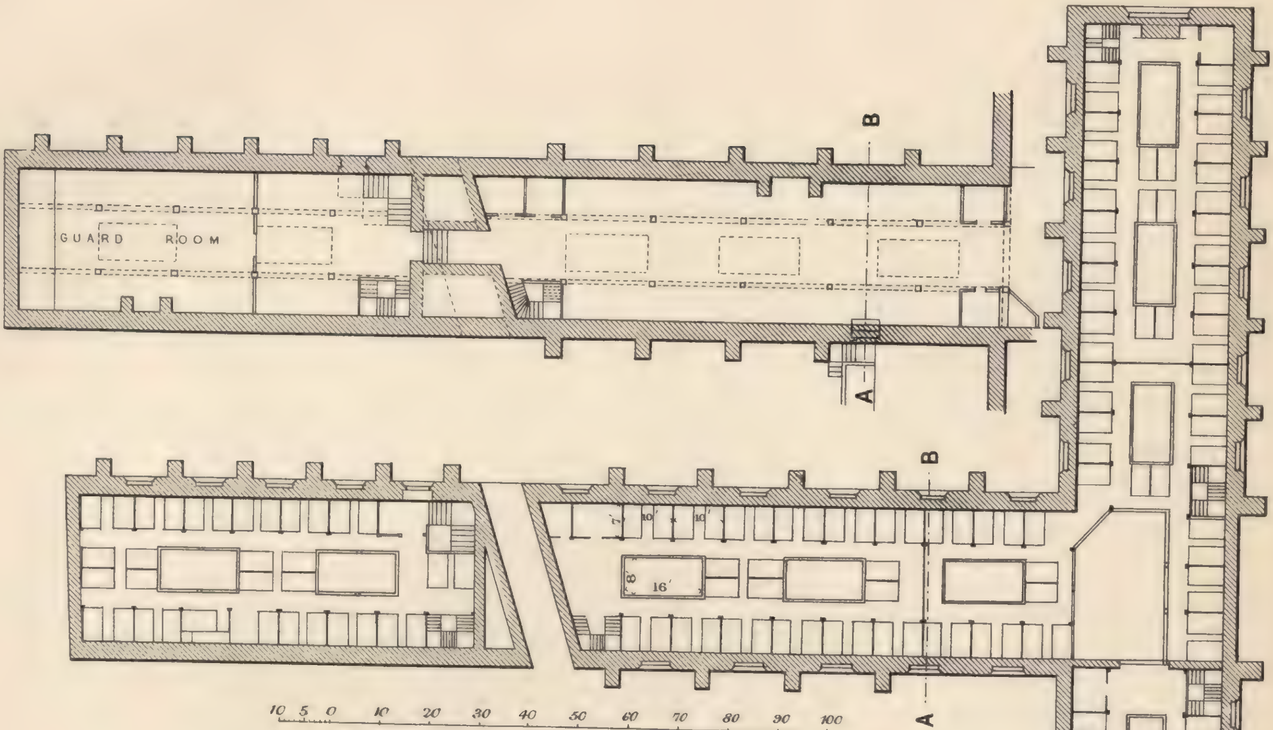
THE OLD BARRACKS

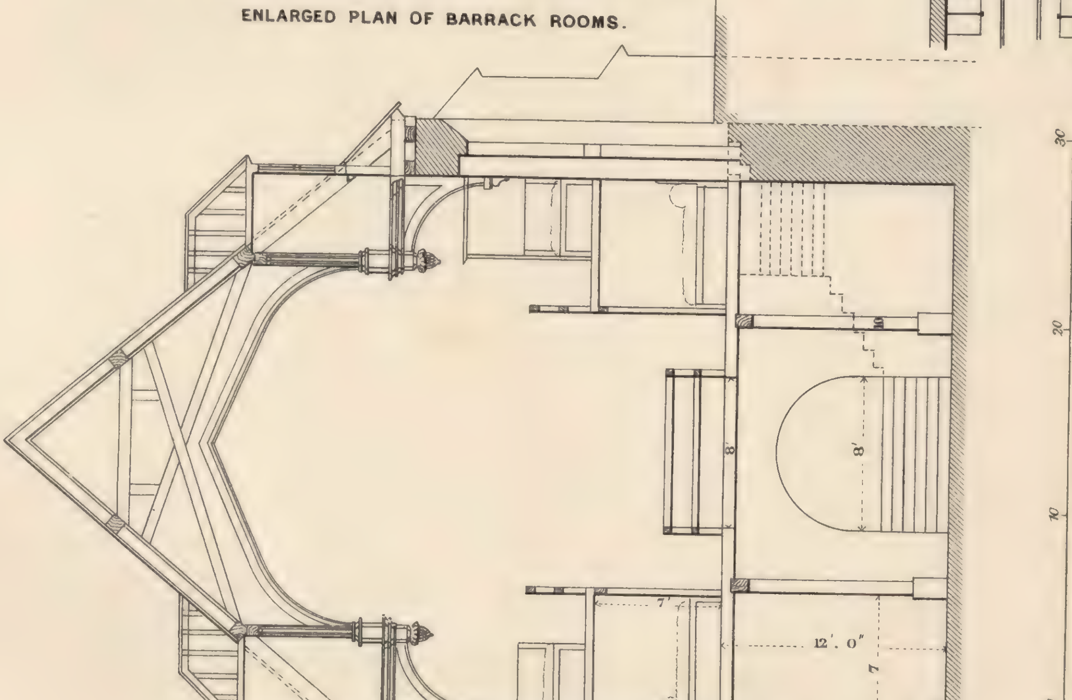
Circa

C F Kell Lith. Castle St Holborn London E C

Reduced from War Office Plan. (Z 6/11)



ENLARGED PLAN OF BARRACK ROOMS.



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forefathers, they were shared by all classes of society. In 1740 suggestions to build permanent barracks were met by General Wade with the statement "*that the people of this kingdom associate the idea of barracks and slavery so closely together that they cannot think of one without thinking of the other.*" In 1766 Blackstone wrote, "*To prevent the executive power from being able to oppress the people nothing should be more guarded against in a free state than making the military form a body distinct from the people. The soldiers should live intermixed with the people. No barracks should be allowed.*" But the crowning argument against the erection of barracks in England was the use to which they were put in Ireland; and it was obvious that the reasons which told for their establishment in the sister isle were conclusive against their adoption here.

The question of providing accommodation for a constantly increasing armed force could not, however, be shelved indefinitely. By 1740 a few barracks of a poor and makeshift sort had been built—furtively as it were—and in 1786 a Military Department was established, on the advice of the law officers of the Crown, but without recourse to Parliament, for building the long-needed barracks, the cost of which was to be defrayed, curiously enough, out of the vote for "the extra-ordinaries" of the army. Accordingly, a multitude of barracks were hastily begun; but some inconveniences and indeed abuses of the system speedily led to their suspension and to the re-opening of the whole question. After enormous sums had been spent in building, for which there was but little to show, the control of the work was placed in the hands of commissioners. The manner in which the building of barracks under Treasury sanction and control, and the various expedients which were tried to regulate the expenditure and other matters, need not detain us; those who are interested in the history of army administration will find in Mr. Clode's *Military Forces of the Crown*,* an able and exhaustive treatment of a complicated subject. Mr. Pitt urged in Parliament that the circumstances of the country, and the general state of affairs, rendered it advisable to provide barracks in several manufacturing centres, and although his motion was negatived on a division his recommendations were put in force. In a very short time barracks sprung up at all our more important towns—at Birmingham, Coventry, Sheffield, Ipswich, Norwich and a host of other places. The date of their erection (1793-7) warns us that we might look to them in vain for any excellence of design. They were hastily planned, and all repeated with but little variation the errors of one defective model. But, as any change in the condition of the soldier was necessarily an improvement, their arrangements and design were not likely to be the subjects of a too fastidious criticism.

They were, however, destined to a somewhat severe criticism later on; for at the close of the Crimean War, and under circumstances which will be in the recollection of many present, Lord Panmure appointed a Commission to enquire into, and report upon, the question of barrack accommodation generally. The evidence taken disclosed the gravest defects in the existing barracks, and showed how inadequate all their arrangements were for the decent and healthy housing of the troops. The Commission warmly and wisely urged that, at a time when large sums were spent in the improvement of gaols and correctional establishments,

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* *The Military Forces of the Crown—their Administration and Government*, by Charles M. Clode. John Murray, Albemarle St., London, 1869.

the outlay should not be grudged which would prevent the accommodation for Her Majesty's troops contrasting unfavourably with that afforded to persons convicted of crimes against society; and their representations mark a turning point in the history of the British soldier.

The Commission prefixed to their report a recommendation that the suitable accommodation for 1000 infantry and a regiment of cavalry should be determined upon, and that the architectural profession at large should be invited to submit plans for the same. The result of the competition was that Mr. George Morgan obtained the first premium for the infantry barrack design, and Messrs. Thomas H. Wyatt and Digby Wyatt that for the cavalry barrack. The infantry barrack was afterwards built at Chelsea, but on a plan so modified that but little of the original design remained. The cavalry barrack has been but lately built at Knightsbridge, from plans supplied by the War Office, but to elevations prepared by the late Mr. Thomas H. Wyatt, and for which he was responsible. Royal Commissions and Committees followed and addressed themselves to the general question and to particular sections of it. It was found that the excessive mortality amongst the troops—no less than twice that of the civil population—was traceable to specific diseases directly induced by the unhealthiness of barrack rooms; by over-crowding, by want of ventilation, by defective water supply and sewerage, and by neglect of sanitary provisions generally. A Special Commission examined and reported in detail upon every barrack in the kingdom; and they were *all* pronounced defective in matters of primary importance.

(*a.*) From want of simplicity in planning.

(*b.*) Because the buildings were so placed on the site as to interfere with the ventilation of each other.

(*c.*) Because the blocks of buildings were lofty and built round enclosed courts.

(*d.*) Barrack rooms were too near boundary walls.

(*e.*) Latrines, urinals, dung-heaps, ash-pits, &c., being placed in the narrow space between the barrack and its enclosure.

(*f.*) The men's rooms were concentrated in large blocks, instead of being distributed over a wider area.

(*g.*) And of course defective sanitation generally.

The best, or rather the least bad, of all the barracks examined were amongst those built in Ireland at the close of the last century. The result of it all was the promulgation of recommendations, which were followed by:—1. Regulations, prescribing the superficial and cubical space to be allotted to each man; 2. Abolishing the old offensive urine tubs from the barrack rooms; 3. Providing separate quarters for married men; 4. Providing baths, washing establishments, workshops, reading and recreation rooms, skittle alleys, &c.; 5. Regulating the warming, ventilation, water supply and drainage.

All the above points are attended to in the construction of a modern barrack, and there is, consequently, at the present time, no member of the community who is better cared for than the common soldier.

1. He is well fed, lodged and clothed.
2. His physical well being is provided for by the inducements held out to him to engage in manly exercises—in fencing, cricket and, what proves to be his pet diversion, skittles.

Project for Hide Parke.

An exact Computation of the Charge of erecting one Barrack, containing in Front 54 Foot & in Depth 45 foot from out to out, & 33 ft. high from the bottom of the Plinth to the top of the Eave Cornish, allowing 6 foot more in the Ground for the Foundation.

		£. s. d.	£. s. d.
BRICKLAYER.	To 220 yards Cube of digging and carrying away the Earth, at 14d. per Yard	12 16 8	
	To 55¼ Rodds of Brickwork, at £5. 5s. per Rodd	290 1 3	
	To 34 Square 65 ft. Slateing, at 30s. per Square	52 0 0	
	To 99 Square of Paveing with 10 Inch Tiles, at 27s. 6d. per Square	136 2 6	516 16 5
	To 27 Foot of large common Sewer, being to be 5 foot high from the center of the Crown of the Arch and 4 ft. wide, the digging included, at 8s. per Foot running	10 16 0	
	To 150 foot of 4 inch arched Drain from the Barrack to the great Sewer, at 2s. per Foot running	15 0 0	
CARPENTER.	To 74¼ Squares of naked Flooring in the 3 Stories, at 28s. per Square	103 19 0	
	To 64 Square 84 ft. of rough boarding under the Square Tiles, at 20s. per Square	64 17 0	
	To 34 Squr. 65 ft. of Roofing and boarding under the Slates, at 40s. per Square	69 6 0	
	To 4 Sqr. of quarter'd Partition, at 18s. per Square	3 12 0	
	To 126 ft. solid Elm Timber for 63 Steps, Stuff and Work, at 12d. per Foot	6 6 0	
	To one outside Door & Door case, the Door to consist of 10 rais'd Pannels, to be fram'd out of double Deale and lin'd on the back side	1 10 0	299 16 0
	To 16 inside Door cases & Doors, at 20s. each	16 0 0	
	To 35 Window Frames, at 8s. ea.	14 0 0	
	To 12 Lucern Window Frames, at 4s. ea.	2 8 0	
	To 12 Oaken Frames for the Sinks and to be boarded fit for Lead, at 15s. ea.	9 0 0	
	To 108 ft. running of double Eav'd Cornish, at 12d. per Foot	5 8 0	
	To 14 Oaken Posts for the outside, 8 In$^{chs.}$ diameter, at 5s. ea.	3 10 0	
JOYNER.	To 161 Yards of double Deal Sqr. Partition for the Closets on ea. side the Chimney, computed double Work, at 2s. 2d. per Yard	17 8 10	19 3 10
	To 35 Window Boards, at 12d. ea.	1 15 0	
MASON.	To 108 running ft. of Plinth, 2 foot high, 6 inch thick, at 4s. per Foot running	21 12 0	
	To 15 ft. running of Purbeck step before the outside Door, at 2s. per Foot	1 10 0	30 6 0
	To 12 Stone Chimney Pieces, at 12s. ea.	7 4 0	
PLAISTERER.	To 1014 Yards of Lathing, Plaistering & Whiting, at 9d. per Yard	38 0 6	61 4 2
	To 1391 Yards of Rendering & Whiting, at 4d. per Yard	23 3 8	
GLAIZER.	To 651 ft. of Newcastle Glass, at 6d. per Foot	16 5 6	16 5 6
SMITH.	To 1 pair of great Hinges for the outside Door	0 5 0	
	To 16 pair of Hinges for the Chamber Doors, at 2s. 6d. per pair	2 0 0	
	To 24 pair of Hinges for the Closet Doors, at 12d. per pair	1 4 0	
	To 4 cwt. 2 15 in the Iron Barrs for the Windowes of the Lower Story, ready cut to a length, at 20s. p.	4 12 6	19 12 0
	To 1 Strong Latch for the outside Door	0 3 0	
	To 16 strong Latches of a smaller size for the Chamber Doors, at 12d. ea.	0 16 0	
	To 47 Casements, at 4s. 6d. ea.	10 11 6	
PLUMBER.	To 2 Ton of Lead for Gutters, at £14. per Ton	28 0 0	
	To 1 Ton 4 cwt. of Lead for the Sinks, at £14. per Ton	16 16 0	53 8 0
	To 8 cwt. of large Water Pipe, at 14s. per cwt.	5 12 0	
	To 36 Yards of small Lead Pipe from the Sinks, at 20d. per Yard	3 0 0	
PAINTER.	To 47 Window Frames, at 18d. each	3 10 6	
	To 55 Iron Barrs, at 1d. each	0 4 7	
	To 1 outside Door-case and Door	0 2 6	4 14 3
	To 24 Yards in the great Cornice, at 6d. per Yard	0 12 0	
	To 14 outside Posts, at 4d. ea.	0 4 8	
PAVIER.	To 876 Yards of paving with Ragg Stone, at 18d. per Yard	65 14 0	65 14 0
	TOTAL OF ONE BARRACK		£1087 0 2

A SHORT DESCRIPTION OF THE WHOLE BUILDING.

It is an oblong Square of 1335 foot in Length, & 369 foot in Depth, and is divided into 3 Courts, the middle Court is 597 foot by 281 clear, the 2 other Courts are each a Square of 281 foot clear.

Each Barrack will contain 12 Rooms besides 4 in the Garrets, each Room being about 20 ft. Sqr., the closet on ea. side the Chimney excluded; the Stair case will be posited in the middle of ea. Barrack, which will be 8 foot in the clear.

At the corner of ea. Court there will be a Pavillion for the Officers' Lodgings of about 55 foot Sqr. from out to out; and in the middle of ea. Front there will be a Pavillion of about 73 foot by 55 foot, in that of the fore Front is the Principall Entry, with large Rooms for the Gate keeper and Guard, the Rooms above are designed for the Barrack Master and his Stores.

The middle Pavillion in the back Front, is to be joyn'd to a peice of Building of about 100 ft. in Length, and both together making about 155 ft. long by 73 ft. broad, which is propos'd to make a Chapple of.

At the South end of the Building there's an Infirmary proposed to be built with a Lodging for the Nurses of about 200 ft. long by 40 ft. broad, as also a Landry of about 100 ft. by 40, besides a drying Yard of about 400 ft. by a 100 ft.

Behind the back Front, along the Park wall next Tiburn road, there's to be 8 necessary Houses, each 20 ft. in Length by 10 in Breadth.

According to the precedent description the whole Building will contain 48 Barracks, ea. Barrack 12 Rooms, which at the rate of 12 men to a Room will contain 144 Men, which compleat about 2 Companies of his Maj^{tyes} Foot Guards, so the whole will contain 6912 private Men; besides the Garrets which upon an Extra Occasion may receive 1152 Men more.

AN ESTIMATE OF THE WHOLE BUILDING AS IT IS PROPOSED TO BE DONE BY A GENERAL DRAUGHT GIVEN IN.

	£. s. d.
To 48 Barracks, at £1087. each	52176 0 0
To 8 Pavillions computed to be done for the value of one Barrack & half each	13044 0 0
To 2 middle Pavillions computed to be done for the value of 2 Barracks ea.	4348 0 0
The Chappel for the value of 1 Barrack and half	1630 10 0
The Infirmary for the value of 2 Barracks	2174 0 0
The Landry for the value of one Barrack	1087 0 0
The Digging and Vaulting under the Nine Pavillions for the conveniency of the Barrack Master, to deposite Wood, Coals, &c., computed to be done for the value of 2 Barracks	2174 0 0
The necessary Houses computed to be done for the value of ⅓ of a Barrack	362 6 8
TOTAL	£76995 16 8

Computed August the 17th, 1716.

Per NICHOLAS DU BOIS, Architect,

and one of his Maj^{tyes} Engineers.

Back of
Foldout
Not Imaged

3. He receives instruction and spiritual consolation from the ministers of his particular creed, and worships in suitable buildings erected for his use.
4. His children are educated, and his own education is extended at his discretion by the facilities afforded him in the shape of reading-rooms, libraries, &c. Every reasonable assistance is given towards making his life a happy one in health, and he is tended carefully and skilfully in sickness.

Before passing on to a description of the present system of barrack planning I wish to direct attention to a plan, which is fairly typical of barrack designs as practised in the last century. It shows an immense project for a barrack* for no less than 7000 men, and is the work of an architect named Du Bois. An estimate, attached to it, gives some interesting information as to prices in 1716—wherein the brickwork figures at £5 5s. per rod.† The arrangements illustrate almost every objection to the barracks of the last century which I mentioned. The building is divided into a multitude of rooms of equal size, back to back, and the only special provision in the way of accessories are a chapel, a laundry and eight "necessary houses." There is an infirmary, which is considerately placed against the only wall upon which private dwellings abut, and there are, moreover, two churchyards or burying grounds, jammed in (one on each side of the chapel) between the main building and the eastern boundary wall. The building was to have been built not so very far from the site now occupied by the present Knightsbridge barracks; but running parallel to and extending along one half the length of the present Park Lane. A great portion of the site is boldly shown as being then covered with water, and the whole is intersected by ditches or watercourses. One cannot help adding that it is a mercy that such a monstrous mistake was never carried into effect.

I am also able to offer an Illustration of barracks in the Savoy upon lines still more primitive, but nevertheless much more conducive to the health of the occupants. The buildings formed a portion of the old Hospital of St. John, originally built in 1245, burnt down by the Rebels in 1381, endowed as a hospital by Henry VII., and after suppression, re-endowment and many vicissitudes, established in 1661 by Charles II. as a hospital for soldiers and sailors. In 1736 the building was occupied as a barrack, probably as represented on the drawings, which are undated.‡ It may be noted in passing that there is not, it is believed, either at the British Museum or in the Crace Collection, so good a plan of the Old Palace in the Savoy, with its several churches, &c., as this one. Each room, or more properly hall, is 220 feet by 30, and the beds are arranged tier above tier, though the height of this particular building (a mediæval one) lessens the objection to their arrangement. The accommodation is for 300 beds; but beyond an infirmary and latrines for 7 seats, without divisions, there are no accessory buildings whatever. The approach to Waterloo Bridge and the Embankment now run over the site, and at the present moment nothing is left of what is shown in the plans but the little Savoy Church.

To come, then, to the barracks built or building under the recent Act. The difficulties of the undertaking naturally begin with the acquisition of the site. It must have, if possible, a

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* See Illustration No. 1, reduced from the original drawing kindly lent for the purpose by the authorities of the War Office.

† See, opposite, a reproduction of this Estimate or "exact Computation."

‡ See Illustration No. 2, reduced from the original drawings, the property of the War Office.

porous subsoil, not encumbered with vegetation, a sufficient supply of wholesome water, and a good fall for drainage. It must not receive and retain the water from higher ground, nor must the prevailing winds bring to it the exhalations from low, marshy or unwholesome districts. It must, moreover, comprize an area of about ten acres, exclusive of training and encamping ground for militia. Considerable tact was required from the Officers of the Department in negotiating for such, especially as the object of their enquiries must necessarily be kept secret. The moment it becomes known, or suspected, that "Government" wants the land a slice of brown heath and shaggy moor assumes in the eyes of its owner the highest building value. In no case, however, have the compulsory powers provided by (Section A) the Act for the acquisition of the land been required to be put in force.*

Having obtained a suitable site the distribution of the buildings on the ground is governed by the following considerations, namely :—

1. A clear space must be left outside the barrack wall. This is necessary in view of the more or less objectionable private buildings which sooner or later accumulate in the neighbourhood of a barrack. Advantage is taken of this necessary belt of open land to lay out the boundary wall on a defensible trace—that is having flanking caponiers, loopholed for musketry, from which every portion of the enceinte could be enfiladed.
2. There must be an ample and a conveniently shaped parade-ground.
3. The officers' quarters should be adjacent to the main entrance, and should, if practicable, have a separate entrance of their own.
4. The store accommodation for arms and accoutrements, on a prescribed scale, should form, or be adjacent to, the guard-room; aud should occupy a commanding position on the site.
5. The hospital should be a detached building on the highest ground available, and to leeward of the barrack.

The other items of a barrack establishment, such as canteens, cook-houses, &c., have in like manner their allotted relation to one another.

All the inhabited buildings must be so placed as to allow of the free circulation of air all round them. When in rows of two or more in depth the distance between the parallel blocks is never less than twice their height from ground to eaves. The axis of each block is arranged where possible to run north and south. Each barrack room is designed to hold one-eighth part of the rank and file comprising a Brigade Depôt, namely 28 men. Each block contains four barrack rooms,† two on the ground floor and two above; the rooms are divided on each floor by a central block, which comprizes the entrance, staircase, the sergeants'-rooms and ablution rooms. Each room is 77 feet 6 inches long, 22 feet wide and

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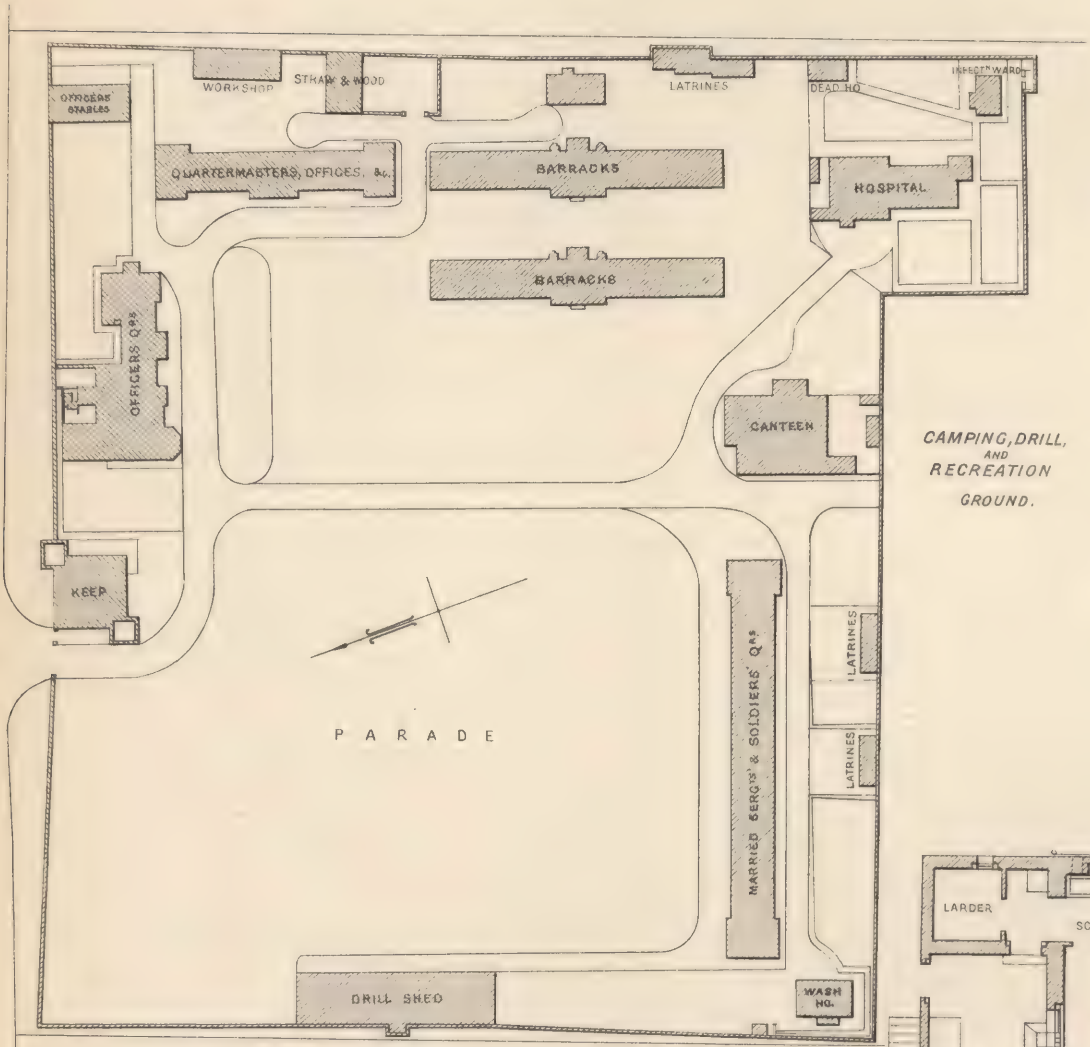
* Up to the 31st Dec. 1880, the state of the Military Forces Localization work is as follows :—New Barracks have been completed at Bedford, Bodmin, Beverley, Bury St. Edmunds, Cardiff, Derby, Devizes, Guildford, Galway, Halifax, Hounslow (2), Kingston, Lancaster, Leicester, Lichfield (2), Lincoln, Oxford, Pontefract (2), Reading, Richmond (Yorks.) Shrewsbury, Warwick, Wrexham, Worcester, Warrington (2), York (2). At Inverness the works are nearly complete. Additional works have been completed at the following Barracks, namely :—Ayr, Ashton, Armagh, Bristol, Bury, Burnley, Brecon, Birr, Canterbury, Carlisle, Clonmel, Chichester, Dorchester, Exeter, Glencorse, Maidstone, Naas, Northampton, Perth, Preston, Stirling, Tralee, Warley, Winchester, Yarmouth. Similar works are in progress at Aberdeen, Hamilton, Omagh and Taunton.

† See Illustration No. 3, containing a transverse section through the Soldiers' Barracks in a Brigade Depôt.

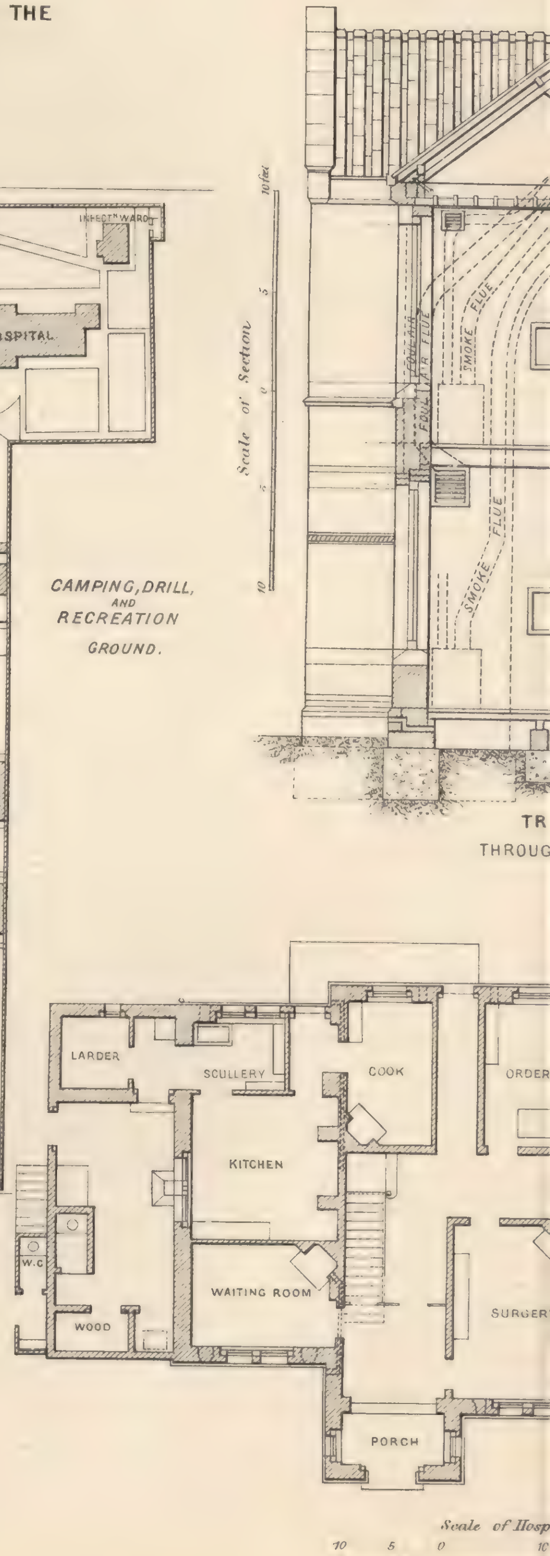
THE MODERN BARRACK, ITS PLAN AND CONSTRUCTION, (Nº 3.)

BRIGADE DEPÔT BARRACKS RECENTLY ERECTED BY THE WAR OFFICE, UNDER THE PROVISIONS OF THE MILITARY FORCES LOCALIZATION ACT, 1872.

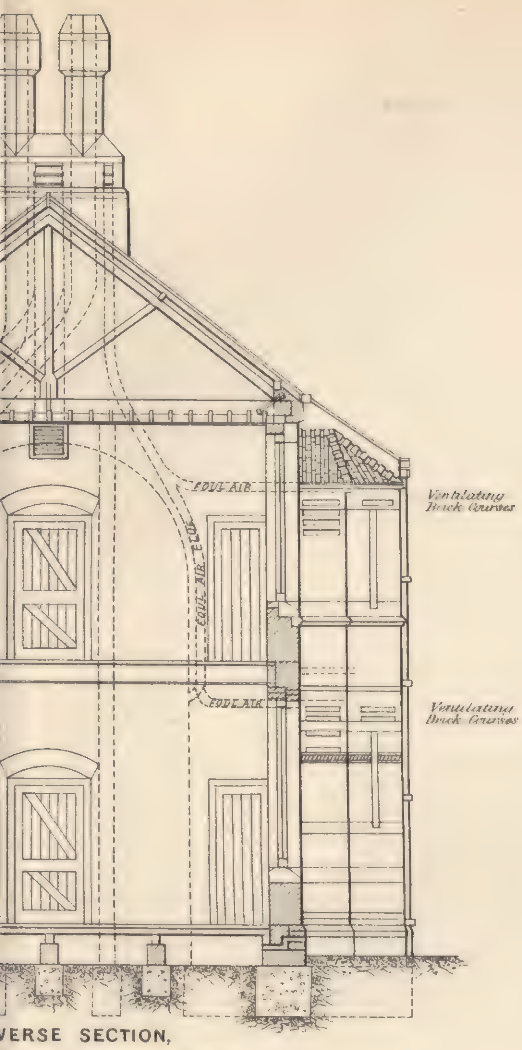


BLOCK PLAN.

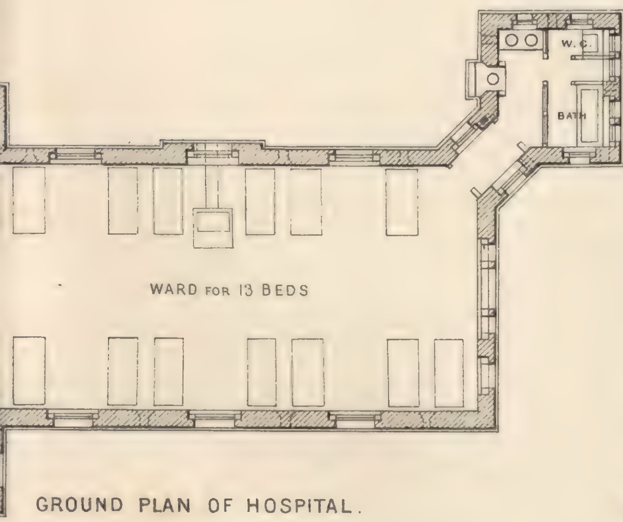
Scale of Block Plan.
100 50 0 100 200feet



C. F. Kell, Lith. Castle St, Holborn, London, E.C.

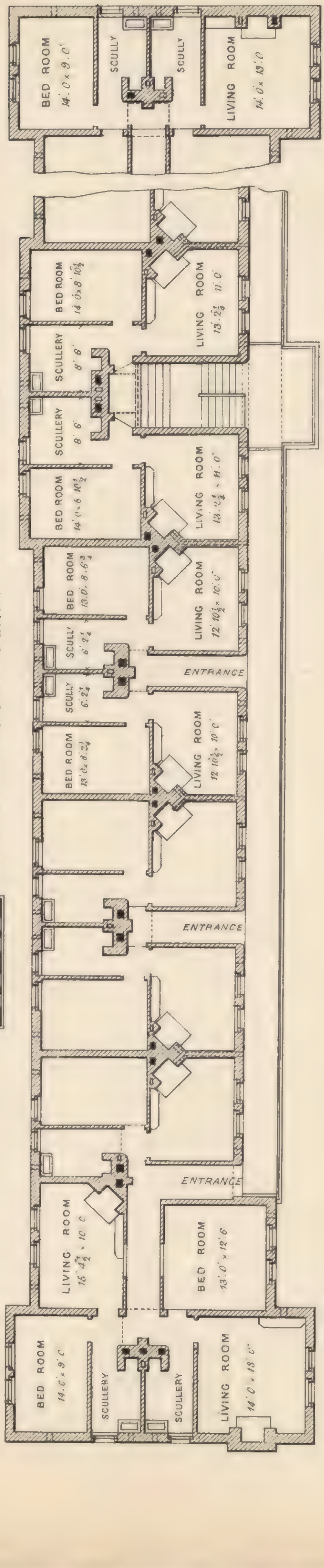


VERSE SECTION,
LDIERS' BARRACK-ROOMS.

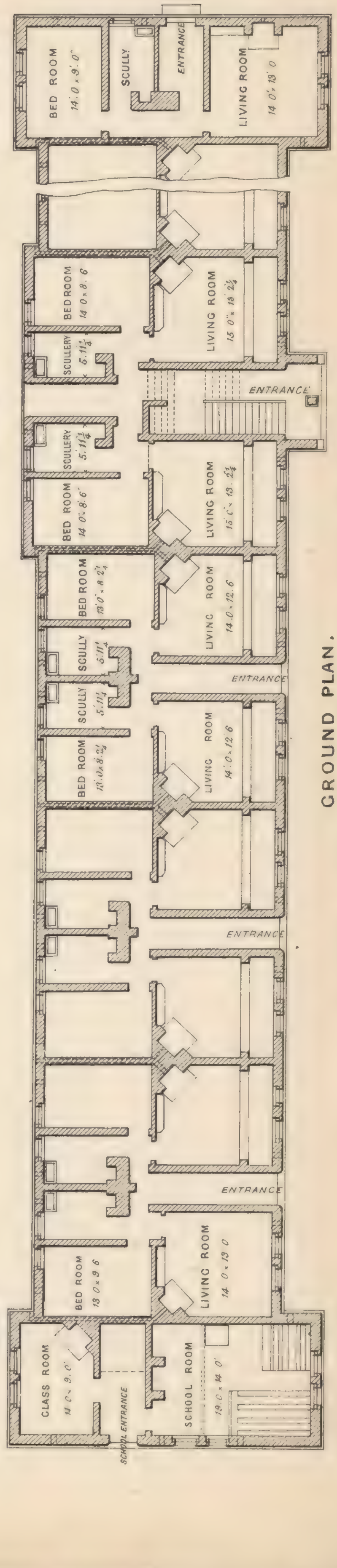


GROUND PLAN OF HOSPITAL.

Plan.
20 30 feet.



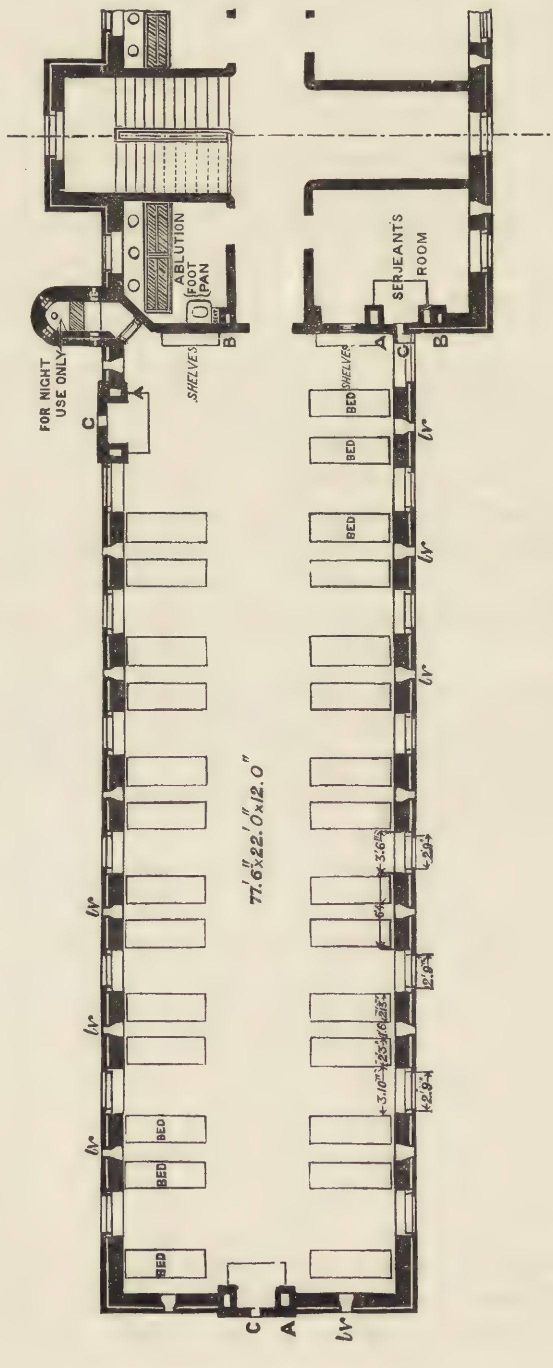
FIRST FLOOR PLAN.



GROUND PLAN.

MARRIED SOLDIERS' QUARTERS FOR 31 FAMILIES, WITH INFANT SCHOOL.
(No Scale.)

12 feet high; it contains, therefore, an area of 60 square feet, and 720 cubic feet of space per man. The rooms are invariably lighted along both sides, and this is of the very essence of the system. The windows are internally 6 feet 4 inches apart, a space which allows of two 27-inch beds being placed between each pair of windows, the beds being 18 inches apart. When a bed comes at the end of the room the space between the wall and the window is 4 feet. The sills are 3 feet 3 inches from the floor, and the windows run up to within 12 inches of the ceiling. Each room has two fireplaces, one in the centre of the end wall and one at the side, between the second and third pair of beds from the opposite extremity of the room. This arrangement is sometimes varied as to the side fire-place, as shown in the diagram. A sergeant's room, 12 feet by 11, in the centre block is attached to each barrack room, and has, in most cases, a window from which the men can be seen. Corresponding in plan to this room there is an ablution room for each barrack room, fitted with wash-basins and a foot-pan; and leading out of the corner of each barrack room, but shut off from it by double doors, there is a recess which is fitted up as a urinal for night use. The floors of the rooms are of wood, and the whole are ceiled at the level of the plates. The materials of which the walls are constructed vary with the locality. Where stone is used the walls are generally lined with brick and have a combined thickness of about 2 feet. Brick walls are built hollow with an external casing of 4½ inches and an internal lining of 9 inches.*



* References in Explanation of the Woodcut.—The openings, some of which are marked *lv* in external walls, are ventilators with movable louvres for the admission of fresh air placed 8 feet above level of floor; the flues not marked with any letter are smoke flues; the flues marked A are for the extraction of foul air; those marked B are small extracting flues; C C C are fresh-air inlets to the Galton grates. The extracting flues from the barrack room are 14 inches by 9 inches: those from the sergeant's room and the ablution room are 9 inches by 4½ inches. The woodcut is the reduction of a plan lent for the purpose by the authorities of the War Office.

It may be convenient while we are dwelling upon the construction of soldiers' rooms, which of course are the governing units in the whole design, to describe the system of warming and ventilating employed; and by way of preface to my description I may remark that the soldier is a peculiar subject to treat in this respect. He is a man who is well fed, and who takes abundant exercise of a violent nature—and the emanations from his body are proportionately copious. He is, moreover, like the class whence he is drawn, extremely sensitive to cold. Further, as we have to give our children untearable books and unbreakable dolls, it is necessary before all things that our soldiers' rooms should be provided, so far as possible, with indestructible fittings. With him, for the most part, valves are simply things to be fastened down, and ventilation openings—like drains—exist only to be stopped up. The simplest and most direct means, therefore, of first of all keeping him warm, and secondly changing imperceptibly the air which he respires, are the ends to be sought.

A long experience of the idiosyncracies of the soldier and the exigencies of barrack occupation goes to prove that, of all the methods of warming barrack rooms, that of the open fire-place is the best, and that the best open fire-place for the purpose is that devized, or rather perfected upon suggestions furnished by earlier models, by Captain Galton. It is so familiar to you all—at least in principle—that I need not go into a lengthy description of it. Fresh air is admitted from the outside and is warmed by traversing certain iron plates or gills in a chamber behind the actual fire; it rises, by its levity, in a special flue provided for it, and escapes, at a temperature of from 55° to 60°, through louvres into the room. The theoretically best level of escape is considered to be 5 feet from the floor; but, in order that the inlet may be out of easy reach, a height of 8 feet has been adopted. Additional inlets for fresh air, on the basis of 1 inch clear aperture for every 120 feet of cubic space, are also provided, by means of louvred inlets between the windows. Outlet shafts, having a clear upcast of 1 square inch for every 60 feet of cubic space in the room, are carried up in special flues in the chimney shafts, near the smoke flues, so as to induce a draught. By this means it is ascertained that the entire volume of air in the room may be changed twice in the hour, without lowering the temperature of the room unduly, and that the barrack rooms are thereby rendered wholesome.

This combined automatic system of warming and ventilating must, of course, be a compromise between conflicting requirements. Under the old system fresh air inlets were undreamt of, and the rooms were warmed at the expense of the purity of the air in them. Under the new system, in some cases, the contrary has proved the case, and the rooms have been over-ventilated—that is, during some exceptionally cold weather, the temperature has fallen below a comfortable level. It is, we all know, easy to warm a room—and equally easy to ventilate it—but it is not easy to both warm and ventilate it at the same time. The difficulty is enormously increased when the ventilating arrangements are necessarily of a fixed nature; for the problem becomes no other than that of applying a constant system to varying atmospheric conditions, and all that can be looked for is a reasonable compromise which experiment will alone dictate. It is, however, certain that the excess of cold is a less objectionable fault than the presence of an atmosphere heated by means, such as the breath of its occupants, which render it poisonous, and that the new barracks err, if at all, on the safe side. A degree or two of cold, more or less, ought not to be of much moment to a

healthy young soldier—and certainly ought not to weigh against the advantage of breathing day and night a pure atmosphere. He, of all men in the world, should not be "coddled." On the contrary we look to him for something of the temper of Othello, when he says that, as one result and condition of his military calling, "*I do agnize a natural and prompt alacrity I find in hardness.*"

The cooking for the men is carried out in a detached building in the rear, fitted with Captain Warren's cooking apparatus and other conveniences. The men take their meals in the barrack rooms, for, although day rooms for this purpose were built at Chelsea and in some other barracks, the outlay in providing them was too great, especially as reading and recreation rooms now form a part of the system.

The married men are housed in separate blocks of specially planned quarters; each family has a living room 13 feet square, a bed room 13 feet by 9 feet 6 inches, and a small kitchen 9 feet by 7 feet, fitted with cooking range and sink. Each living room and each bed room has a grate, and upcast flues as before described are provided for the living rooms. The blocks are two or sometimes three storeys in height—11 feet from floor to ceiling—and are arranged in pairs with a common entrance and staircase between them. At one end of the block is placed a school with adjacent class room, and over it the schoolmistress' quarters with a separate entrance and staircase. At the opposite end of the block are placed the laundry and wash-house for the whole of the married quarters. In a spare piece of the staircase landing at the top floor a W. C. for women and children is provided; but the quarters are provided for ordinary use with latrines, suitaby divided, in detached buildings in the rear. The married quarters are placed, as far as practicable, from the barrack rooms.

The sergeants are provided with a mess establishment, comprizing a mess-room, mess-kitchen, larder and cook's room. These are sometimes under the same roof as the canteen, and the upper storey is allotted to the canteen sergeant's quarter, to a recreation room where chess and other games are played, a reading-room, library and librarian's quarters. The same principle of warming and ventilating is adopted throughout, and the establishment forms in fact a little club furnished with comforts, aids to study, and means of wholesome recreation, for the like of which a City clerk scarcely knows where to look.

The officers' quarters, with their attached mess-room—and sometimes a billiard room—call for no special remarks. Each subaltern has one room 21 feet by 14, a captain has two rooms, and a field officer has three such. The quarters are built in two floors, with servants' rooms in the roof.

The hospital presents no features but such as are common to the best examples of its class, and as hospital construction has attracted so much attention of late years, and comes so frequently within civil practice, I will say but little under that head. Great care is therein bestowed upon sanitary matters. The principle adopted throughout is that expressed by the motto of the late Charles Mathews, "keep moving:" copious inlets of fresh air, ample outlets, and such inducements to upcast currents as the neighbourhood of smoke flues, exhaust cowls, and such like afford. Portland cement concrete has been used for floors, roofs and similar purposes with economy and success. Horizontal slabs of concrete 6 inches thick, with a bearing one way of 7 feet and lengthwise of 13 feet, have safely supported a distributed load of $1\frac{1}{4}$ cwt. to the square foot. The very careful instructions issued by the War Department

as to the composition and use of this material, will I think be found quite worth your perusal.*

I shall, perhaps, be expected to touch upon the systems of drainage and sewage conservancy adopted in camps and barracks. This is, however, a subject which would require a separate Paper for its adequate treatment; and, as I am given to understand that a Paper on the subject generally will be delivered in this room during the present session by a gentleman possessing special qualifications for the task, I will do no more than give the conclusions to which the experience of the War Department has led. The question lies practically between the system of water carriage and disposal of the sewage matter, and that known as the dry-earth system of conservancy. It is commonly thought that the latter is the proper

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* The Official Specification for forming the Concrete floors and roofs of Keeps at the Brigade Depôts is as follows:—

1. (*Centering*). The centering to be constructed in the following manner or as may be apporoved, viz.:— Longitudinal pieces of fir, of convenient scantling and length, are to be placed on the lower flanges of the girders, and to be raised or lowered on the same by wedges placed beneath them; on these are to be placed transverse pieces of sufficient strength and rigidity to carry the boarding, which is to be not less than an inch in thickness and to be close jointed, or the joints may be closed with fine plaster. The whole to be so constructed that the centering shall firmly support the concrete.

2. (*Floors*). The floors to be formed of the thickness, and as shown on the drawing, the upper surfaces to be left rough to form a key to receive a thin coat (not less than ½ inch in thickness) of equal portions of cement and clean coarse sand, or sharp clean fine grit, which is to be applied *as soon as possible* after the concrete has been laid; this thin coat is to be well incorporated with the concrete, by floating with a hand float, and finished by being well trowelled to a fair and even surface.

3. (*Roofs*). The roofs to be formed and finished as described for floors, except that they are to be constructed to the required forms and falls as shown on drawing; the concrete to turn up against all walls, chimney shafts, &c., to a height of 2 inches, the cement finishing coat being worked up against such walls to an additional height of at least 2 inches and carefully bevelled off at the upper edge. The upper surfaces to be twice payed over with coal tar and pitch well boiled for about 1½ hours and applied hot. The last coat to have fine grit sifted over it. N.B.—The pitch should only be mixed with the tar during the last 15 minutes of boiling. The proportion may vary slightly according to the consistency of the tar, but about 1 pitch to 4 or 3½ tar will generally be found sufficient.

4. The floors and roofs to be laid in *bays*, the joints (where the work is left off and recommenced) should be in the centre of the girders, and each bay (running the entire length of the floor) to be commenced and finished within the day, so that it may form an entire slab.

5. (*Materials to be employed*). The concrete is to be composed of 1 part cement to 4 parts breeze, or other approved porous material, such as iron slag, hard brick rubbish, well burnt clay, &c., which must pass through a ⅝ inch mesh, such materials will generally contain a proper proportion of fine stuff, but should the latter be less than ⅙th of the whole, more should be added; breeze or Smith's ashes may be used for the purpose, but not sand, and in no case should the fine stuff exceed ⅓rd of the whole. The breeze to be obtained from Gas Works or similar source, to be perfectly clean, and free from unslaked lime. The ashes to be clean and free from dust or soft matter, the materials must be free from all clayey or loamy matter, and must, if necessary, be washed clean.

6. (*Cement*). The cement to be Portland, and:—I. To be fine enough to pass a sieve of 2,590 meshes per square inch without leaving more than 20 per cent. behind. II. When made up net, and filled into a glass bottle or similar article, and struck level with the top, it must not in setting, crack the vessel or rise out of it, or become loose in it by shrinking. III. When made up net, and filled into moulds, it must, after seven days in water, be capable of giving an ultimate strength, under a tensile stress, slowly applied, of 250 lbs. per square inch of fractured section. The immersion in water to commence as soon as the cement blocks can be safely removed from the moulds, which must not exceed twenty-four hours after the moulds being filled.

7. (*Mixing of Ingredients*). The ingredients to be mixed by being first twice turned over dry, then shovelled to a third heap, at the same time adding from the rose of a hose or watering-pot sufficient water only

method to adopt. But there are considerations which come in to modify, or alter that view. Special arrangements and mechanical contrivances are not alone necessary, but a sufficient supply of suitable soil, *i.e.* garden mould, must be available; and, what is more important still, an unfailing regularity and care in the removal of the soil and its subsequent distribution. Moreover the urine must be separately drained and disposed of, or the enormous quantity of dry-earth would, for a large barrack establishment, be such as to defeat or seriously hamper the working of the system. It is a *sine quâ non* that provision must be made for draining the barrack or camp buildings, whatever system of latrines be used. The refuse water of lavatories, sinks, cook-houses, wash-houses and urinals, must be provided for. And the same drain that conveys away the barrack sewage is sufficient to cleanse the latrines. The special committee appointed to deal with the subject recommend that wherever latrines can be supplied with water, and an outlet obtained for the sewage, it is quite unnecessary to discuss any other method of conservancy. To adopt any other would be a useless waste of money. Water latrines require a certain amount of care to keep them clean. But the great object of collecting and removing the excreta is not, as in the dry-earth system, done by irregular, fallible labourers or contractors, but by the law of gravitation. Pulling a handle, with occasional cleansing of the surface, is all the care required, and the contents are washed away beyond the barrack boundary altogether. By the other systems some delays *must* take place, and in the meantime injurious emanations may be given out. Further, if the earth after removal be not properly distributed, but is buried in holes, the old evils of cesspits are reproduced, and a serious risk is run of polluting the subsoil water and poisoning the wells.

The arrangements above imperfectly described are not, as may be supposed, rigidly adhered to in every instance; on the contrary the additions to some of the old barracks on limited sites, or the building of new ones, as at Knightsbridge, under similar conditions, afford plenty of opportunities for skilful planning. In the latter instance the cook-houses and some other offices are on the upper floor of the building, the women's wash-house and drying grounds being concealed by the roofs. Considerable ingenuity was required in bringing into a space, originally confined, and further curtailed by the road improvements, all the demands of so large an establishment. The average cost per head of accommodation was,

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to make the ingredients *cling* together. The broken material and breeze should be well damped previous to mixing, but must not be wet on the surface when mixed.

8. After the concrete has been deposited in its position, it is to be lightly rammed with wooden beaters until the moisture comes to the surface.

9. All edges or surfaces, where left off, that have become dry, are to be swept to remove any dust and to be well wetted before recommencing.

10. (*Not to be disturbed whilst setting*). Every care is to be taken not to disturb the concrete whilst setting: should it be necessary to pass over it when newly formed, planks are to be carefully laid down for the purpose. The centering is not to be disturbed for at least fourteen days from the time of laying the concrete. Precautions must be taken to protect the finished surfaces from being injured by traffic or falling materials, &c.

11. (*To be kept damp*). The concrete is to be kept damp for at least fourteen days after its formation, by flooding it with water, or covering it with damp saw-dust, sand, or otherwise as may be approved, the sand, &c., to be kept damp during the period of fourteen days by sprinkling it with water from a rose.

12. (*Soffits*). All exposed soffits of roofs, floors, &c., to be rendered smooth with equal portions of cement and sand, just sufficient to fill the interstices. The soffits to be well wetted before commencing.

13. (*Work not to be executed during frosty weather*). The work is not to be executed during frosty weather, or even if there should be any probability of a frost occurring before the concrete has had time to set.

for such a barrack as that proposed in 1716 and for those built in the middle of the century, about £12 per head. The cost of the new Chelsea Barracks was about £225 per head. The cost of the Brigade Depôts averages £200 per head—the barracks proper coming out at 5½d. per cubic foot, the married quarters at 6½d., and the officers' quarters at 8d.*

In comparing a barrack such as I have been describing with those of the preceding century—in which it was not uncommon for the beds to be in two tiers with four soldiers to a bed—it must be evident how much the modern soldier is ahead of his predecessors in solid comfort. It is due to the late Lord Herbert (and those who, succeeding him in office, have carried out the policy he inaugurated) that the condition of Her Majesty's troops no longer "*contrasts unfavourably with that of criminals;*" and there can be now no doubt but that the new system acts advantageously, not only on the health, but on the morale of the army. From particulars which have been kindly furnished by Dr. Sutherland†—whose labours in connection with the improvement of barrack hygiene must be known to many of you—I am enabled to give the following statistics as to the improved health of the troops:—

In 1857 the death-rate of male civil population between the ages of 20 and 40 . . . . . = 9·8 per 1000

That of the troops, within the same periods . . = 17·11 „

Or nearly double that of the civil population, as before stated.

In 1876 the corresponding rate for the civil population . = 10·2 „

That for the troops . . . . . = 8·55 „

It is possible that these figures do not represent exactly the relative rates, or that the years chosen—simply because the returns for those years are at hand—may have been exceptional. The problem is a complex one, and there are considerations connected with it which might modify, perhaps very considerably, the above results. Nevertheless, when the fullest allowance has been made, the broad fact remains that, under the *old* system of barrack construction, administration and economy—for questions of diet and other matters must be taken into account—under the *old* system, then, the military death-rate was, to say the least, very greatly in excess of the civil rate, whilst under the new system the military rate has fallen appreciably

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* See Illustration No. 3, reduced from working drawings, prepared by the War Office, of a modern Brigade Depôt.

† Dr. Sutherland writes, on the 8th November, 1880:—

Dear Mr. Bell,—At page 526a of the report of the Royal Commission on the Sanitary State of the Army, 1857, you will find the following facts for the army anterior to that time:—

Deaths per 1,000.

	Ages 20-25	25-30	30-35	35-40
Englishmen	8·4	9·2	10·2	11·6
English Soldiers	17·	18·3	18·4	19·3

The Army Medical report for 1876 gives the following facts for men who have entered their regiments:—

	4·95	6·53	8·17	14·57

At page vii. of the Royal Commission report the average death-rate of all ages of the home army is given at 17·5 per 1,000. At page 2 of the A.M.D. report for 1876 the total death-rate for all ages is given at 8·43 per 1,000 for the home army. These are official, but some corrections in certain of the rates might possibly be made, but these would leave the figures practically as they are for comparison. We have no horse statistics, but in our stable report you will see Mr. Wilkinson's opinion. I am sorry I shall be unable to attend your lecture from distance and health.—Yours ever truly, J. Sutherland.

below the civil rate for corresponding ages. Another fact, supporting and in short a corollary of the preceding, is that whereas the permanent hospital allowance was previously ten per cent. of the barrack occupation, it is now found that six per cent. amply meets all requirements.

The same care has been bestowed upon the arrangements for cavalry and artillery stables,* and the improvement in the condition of the horses has kept pace with that of the men. The old plan of arranging the stalls transversely to the block of the building—by which the end horses got all the light and fresh air, and the central horses darkness and foul air—has been abandoned. Cavalry stables are now arranged generally in two rows of stalls, the heads of the horses in each case being against an outer side wall and the heel-posts separated by a passage 12 feet or 13 feet wide. Every horse is allowed at least 1200 cubic feet of space—practically he gets in most cases 1279 cubic feet. A window is placed over every stall and 8 feet above the floor, so that a horse can stand without being subjected to the direct rays of the sun. When possible a continuous skylight runs along one-half the length of the building on the side least exposed to the sun. All the stable windows are made to open, either swinging on pivots or being hinged at the bottom, and opening inwards. The roof, where practicable, is open and provided with continuous ridge ventilation along the central half of its length ; this admits of being closed on either side, but not on both sides at the same time. A course of perforated bricks for the admission of fresh air is provided along the eaves, giving an area of not less than 144 square inches of clear opening per stall. An air grating with a clear opening of about 40 square inches is placed between each pair of stall windows, and 6 inches above the ground, so as to provide fresh air for the horses when lying down. When rooms are built over stables, foul air shafts are carried up from the stables discharging above the roofs, in connection with smoke flues, or provided with exhaust cowls. These shafts have a sectional area of 18 inches per horse. The paving, which is of granite or hard stone pitchers, slopes at 1 in 80 from front to rear of stalls, and 1 in 40 from sides to centre. The stables are drained by surface channels only, formed of a hard impervious material laid down in long lengths and having a shallow cross section. They are invariably carried to a distance of 12 feet outside the stable wall before discharging into a gully trap. Infirmary stables are built in one row of stalls only, with a minimum height of 14 feet and cubical space of 1800 feet per horse. The lighting and ventilation of these are the same as for troop stables. The loose boxes are 17 feet by 12 feet and 12 feet high, and allow 2500 cubic feet per horse. The improved health of the horses†, as shown by the official returns, testifies to the advance which has been made in the construction of this class of buildings.

For the corresponding advance which has been made in the architectural treatment of barracks generally, I can point, with some confidence as to your verdict, to the drawings for the barracks now erecting at Inverness. An attempt has been made—and I submit successfully made—to give to each function of the establishment an appropriate expression, and, without resorting to any capricious or extravagant forms of architectural design, to produce an agreeable effect indicative of the respective purposes of the various portions of the building.

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* See, page 38, an extract, referring to the plan and construction of stables, from the Report of the Barrack and Hospital Commission, 1864.

† See page 40, an extract from a Paper read before the Statistical Society by Surgeon-General T. Graham Balfour, M.D., F.R.S., on *Vital Statistics of Cavalry Horses.*

It is now scarcely possible, on entering a barrack yard for the first time, to mistake the appropriation of the blocks of buildings composing the establishment. The guard house at the entrance, the keep and store of arms plainly bespeaking their purpose, the officers' quarters and those of the men, and the various accessories, all falling into due subordination and being severally distinguished by appropriate and characteristic treatment. I may add that comparative analytical estimates, based on quantities, show that the general system of grouping and arrangement is less costly—notwithstanding its improved appearance,—than the obsolete plan of crowding every element of barrack life within four lofty walls and under a single roof.

I wish to add a word as to Continental barracks. With one exception, and that is an important one, the great military powers on the Continent have not moved with this country in the matter of barrack planning. The last definite information I have available is that conveyed in the plans, elevations and view of the new barracks for the Imperial Guard at Vienna; in these are repeated many of the condemned features. They form an enormous agglomeration of rooms, several storeys in height, built round open courtyards. At a first glance there may be no great apparent difference between the new Knightsbridge Barracks and those at Vienna; but a closer examination will reveal the fact that there is a radical difference in the plan of the two establishments. At Knightsbridge every barrack room conforms to the Brigade Depôt type previously described, and is lighted along both of its longest sides; the Viennese barrack rooms are long and narrow, placed transversely to the block of building, and each room is lighted at one end only.

The exception I have referred to is no other than our neighbour France, who is not only following our lead, but acknowledging her indebtedness to the researches and experiments of the English Government. In an official report, dated 1879, M. Émile Trélat—the mouthpiece of a committee* and a distinguished architect—speaks with enthusiasm of the initiative taken by Lord Panmure, and followed by Lord Herbert, in efforts to ameliorate the condition of the soldier. He gives full credit to the labours of the various committees, the researches of Drs. Sutherland and Burrell, and of Captain Galton; and he deplores the fact that while for the last ten years we in England have been giving effect to their recommendations, to the manifest benefit of the troops, France has continued to build down to as late as 1874 on the old plan.† That plan is singularly like our defective plan of the last century: enormous

* Rapport (1879) sur le nouveau casernement de Bourges présenté à la Société de Médecine Publique et d'Hygiène Professionnelle—M. Émile Trélat, Rapporteur.

† The Report contains the following passage :—

Comment oublier que c'est en 1857, il y a 22 ans, que les belles instructions de lord Panmure confièrent à une commission de trois membres (Dr. John Sutherland, Dr. W. H. Burrell, Captain Douglas Galton): 1° le soin de visiter toutes les casernes et tous les hôpitaux militaires du Royaume-Uni ; 2° l'autorité de dépenser directement dans chaque établissement jusqu'à concurrence de 2500 francs, et à la seule condition d'en dresser rapport, afin de remédier immédiatement à l'insalubrité des locaux occupés par l'armée ; 3° le droit de présenter à l'approbation du ministre toute dépense supérieure qu'ils croiraient utile au même but ?—Comment oublier que ces mêmes instructions recommandaient aux trois commissaires d'observer tout avec soin, d'appeler et de questionner toutes personnes compétentes, et d'employer tous les moyens qu'ils jugeraient convenables pour se faire une opinion nette sur toutes les causes de maladie ou de mortalité dans les casernes et les hôpitaux, afin de rédiger un programme des améliorations à introduire dans les établissements militaires ?—Comment oublier qu'en moins de quatre ans, dès 1861, un rapport-programme, œuvre considérable qui reste un des meilleurs documents d'hygiène publique, était achevé, présenté à lord Herbert, Ministre de la guerre, et libéralement porté à la connaissance du public ; et que *dix* ans après, en 1871, un nouveau rapport relatait les résultats produits par la réforme du

blocks of many storeys, badly arranged on the ground; rooms end-lighted and placed back to back with either a wall or a passage running longitudinally down the centre of each block; too low a cubical space, averaging only about 380 cubic feet per man, and in short enumerating almost exactly the defects of our own earlier barracks. The committee unanimously recommend the abandonment of this type which they call the 1874 type, because it continued to be built to that date, and while adopting the English system of distributing the buildings, they carry it to even greater lengths, and allow no upper storey at all. There is also much stress laid upon what is called the infectable area of materials per man in the older buildings, quite a new view of the subject so far as I know. The committee say that while inspecting the old barracks at Bourges, though all the windows were open and everything had been done to air the barracks, they nevertheless could not escape that smell, *sui generis*, which, they say, has earned the name of the "odeur de caserne." For eighty years the walls, floors and ceilings have been subject to and have absorbed the emanations from the bodies of the men, and those arising from the exigencies and usages of barrack life, and the fabric has become incurably impregnated with filth. The periodical lime whiting, which our barracks undergo, is not referred to in the report, and I cannot say whether it is practised in French barracks. But even with this precaution it is impossible to read, without nausea, some of the evidence given before the various committees as to the condition of our older barracks before their reform was taken in hand.

Although the subject of my Paper may not have any direct bearing on the work of the civil architect, yet in view of the above facts its use may prove, as Bacon says, "*collateral and intervenient*," if we can bring to the consideration of problems, present to us in civil practice, the facts evolved and the experience gained by the labours of the Government Committees; and it may be that in the construction of those enormous modern buildings such as workhouses, asylums, model dwellings and similar huge works, some lessons as to the relative desirability, concentration and dispersion of the elements of accommodation may be learnt from the foregoing. I have only one word to say in conclusion, and it is that, as I have had no hand in the preparation of the designs we have been discussing, I can claim no credit in respect of them. Although I have been for twenty years and more connected with the Works Department of the War Office, my official duties have nothing to do with barrack planning and design. The designs are in fact prepared in the department of the Inspector-General of Fortifications, who is also the Director of Works. He is assisted by a Deputy Director of Works for Fortifications and another for Barracks. The drawings are prepared by civilian draughtsmen

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casernement et les incontestables bénéfices sanitaires obtenus sur la totalité du territoire anglais. Les nouveaux casernements anglais sont des installations disséminées sur de larges espaces. Les constructions sont nombreuses et de capacité restreinte. Il y a vingt ans, nos voisins faisaient beaucoup en réduisant le nombre des étages à deux plans d'habitations, un rez-de-chaussée et un premier. Cette solution a été menée à bien ; mais elle comporte une certaine complication dans les appareils nécessaires à la ventilation. L'administration anglaise s'est aussi attachée à réunir toutes les conditions favorables à la propreté des locaux et des hommes. De là, une seconde espèce d'appareils assez nombreux, mais très efficaces. Au demeurant, la réforme anglaise est une solution qui aurait pu être moins coûteuse, mais elle est indiscutable dans ses résultats. Qui pourrait en douter? La mortalité dans les anciens casernements anglais était en 1857 de 17.60 sur 1000 pour le Royaume-Uni. Elle atteignait 69 sur 1000 dans les Indes. À mesure que la dissémination et l'amélioration des locaux s'effectuèrent, la mortalité baissa. En 1877, elle n'était plus que de 7.20 sur 1000 pour le Royaume-Uni et de 12.71 sur 1000 pour les Indes.

in a section of the Barrack Department called the designing branch. This branch is at present under the direction of Captain Marsh, R.E.; but the bulk of the Brigade Depôt work was got out, and the types were settled, while the post was held by Major Seddon of the same corps.

CHARLES BARRY, F.S.A., *Past President.*—Mr. President, I have joined with you, and I am quite sure with all present, in the interest with which we have listened to the Paper Mr. Ingress Bell has read to us. In the earlier period of it, it is interesting from its historical character as giving statistics of the early construction of the particular buildings under discussion, which are of considerable value. In the latter part of the Paper there is given a certain amount of authoritative information deduced from the most expensively conducted experiments which could be undertaken for the object in view, and which experiments could only be carried out by Government, and such may be of great use even to us, who are not permitted to interfere with military buildings, but are condemned to civil architecture only—I say they may be of great use to us even in that humbler sphere of action. The action of the War Office seems to have been tolerably consistent from very early times; it has taken its own way and gone on its own path. It has not sought any aid from those outside amongst ourselves—save when, for once, independent minds were asked to help the warlike authorities; but then the competition plans were set aside, and the actual plans of the building, though not the elevations, were designed by the authorities of the War Office. Anything more unsatisfactory to us artists could hardly be mentioned. We are under the delusion—it is a widespread delusion amongst the profession—that outside and inside should go together, and that you cannot plaster on an elevation to a self-constituted plan with any reasonable success. I could only sympathize—I was going to say I could only pity our late friend Mr. Wyatt—in having such a very difficult and most unsatisfactory problem to work out, and above all, to leave behind him. We may gratefully acknowledge the results of the various inquiries into the sanitation, the ventilation, the dealing with the water supply, and the conveyance away of refuse matter, excreta, &c.—purely scientific inquiries for which we cannot but be thankful to the Government for having carried out in the way they have. They appear to have their reward by the facts Mr. Bell has laid before us—that in 1857 the average mortality amongst the civil population was 9·8, and amongst the military 17·11, and that is quite sufficient to carry off the shortcomings of the department—while there is the contrast that in 1876 the civil deaths per 1000 had increased from 9·8 to 10·2, while the deaths amongst the troops housed in barracks had been reduced from 17·11 to 8·55—a most remarkable result; and moreover, that the demand on the hospital, which was at the former period 10 per cent. was at the later period 6 per cent. May I venture to suggest that the same data—precisely the same data—are wanted and may be beneficially used in many of our public buildings, and latterly in that new feature which has been introduced into society in London with, I hope, very beneficial results—the better housing of the poorer classes of the community. May I not hope that the enthusiastic attempts which are made by various bodies, public and private, to build better dwellings for the industrial classes will, when they have some statistics laid before them, be able to show some no insignificant results as the reward for the efforts made? One piece of information may have surprized many of the gentlemen in the room, as it surprized me, which is as to the cost of building barracks. Mr. Bell spoke of 5½d. per cubic foot, in these present days of expensive

labour, for the men's quarters; 6½d. for what are practically dwelling houses, the married soldiers' quarters; and only 8d. a foot for the gentlemen's residences, called officers' quarters. This struck me with a good deal of surprize. I presume that all the works are carried out by competition amongst builders, and that only an ordinary percentage of builders are ruined by the contract! As regards what he tells us has been done at Inverness, I shall certainly hope for an opportunity to travel there, unless the War Office will be good enough to erect at a less distance equally satisfactory buildings. As to the Inverness buildings Mr. Bell makes the bold claim of success by the War Office in one of the most difficult problems of our profession—one which we strive after all our lives, and in all our works, but one we seldom if ever think we have entirely attained. He claims that all the buildings there and all parts of those buildings are consistent in character, satisfactory in aspect; and that each portion of the design bespeaks its objects. No less a claim was laid down for the Inverness Barracks. All I can say is, that if they do satisfy that very high standard it will be one of the most remarkable successes that can be achieved. Of course, that judgment will somewhat depend on the point of view taken and the person who views it. He told us of some of the personal peculiarities of soldiers as tenants, and a soldier after all is only one example of a number of men who live together; soldiers are not the only persons who fasten down valves that ought to be free, and not the only persons who stop up ventilation openings intended for their benefit. I have heard of artizans having very similar proclivities. Then he very truly said it was easy to warm a room and equally easy to ventilate it, but not equally easy to warm and ventilate it at the same time. No doubt, it is not easy, but with all the scientific assistance at the command of the War Office I suppose it will be done, or is done every day. In buildings where the rooms are small, the difficulty is no doubt intensified. A small room is far more difficult to warm and to ventilate than a large one. 720 feet, he says, of cubical space are allotted in their buildings to each soldier, and I think I am right in saying that that is something like the allowance in our union workhouses.—[The CHAIRMAN here stated that 600 feet is the allowance, but that it is generally exceeded.] I dare say the 720 feet is enough. Then came the question of cost per head, and the average must be deduced from a great many differing instances. He gives us a definite one at Chelsea:* £225 per head. It is perhaps difficult to compare barracks with other buildings; the nearest approach would be our public boarding schools where they have large rooms with dormitories, master's house, &c. I think that £225 is a very high average, as far as my own knowledge goes of the cost of public schools. The Paper, however, is a very interesting one—full of details, which will be of great use to us in our records for reference. They do not admit of very much discussion, but as matters of reference and experience they will be of the greatest possible value. There is another gentleman in the room who will be able to give us much real personal information on such important subjects; for we have the advantage of the presence of Dr. Balfour, who was the Secretary of the Royal Commission appointed to enquire into the sanitary condition of the Army and presided over by Lord Herbert. He must, therefore, have had great experience of the early difficulties surrounding the case.

SURGEON-GENERAL T. GRAHAM BALFOUR, M.D., F.R.S.—I rise with diffidence to say

* Mr. Ingress Bell states that the cost of the new Knightsbridge Barracks has been £361 per head, or excluding the cost of stabling, £286 per man.

a few words on this subject, because I think it almost impossible from a mere hearing of a Paper read to be prepared to state such detail of facts as would carry conviction to such a meeting as this; besides which, you must remember that my point of view is probably different from yours. I look upon these questions from a sanitary point of view—you look upon them, I presume, from a constructive point of view; but I think the two ought always to work together. I have heard the Paper with very great pleasure, because it conveys to me the impression that the War Office during the last twenty years has been carrying out to the full—at least so far as it can with the amount of money voted by Parliament—those principles laid down by the Commission of which Mr. Bell has told you I had the honour to be Secretary, and presided over by one of the best friends the soldier ever had—the late Lord Herbert of Lea. But in commenting upon the Paper I am quite sure Mr. Bell will excuse me if I indicate one or two points on which I think he is slightly mistaken. He began the Paper by referring to the state of the barracks in the last century and their very defective condition, but I think he might have gone very much beyond the last century, very nearly to the middle of this century, in considering defects of barracks. I was appointed in 1836 with the late Sir Alexander Tulloch and Deputy-Inspector-General Marshall to report upon the health of the troops for a period of twenty years, the report being compiled from the returns furnished annually by the medical officers of the army to the Director-General. Among the curious things we discovered were some facts with regard to the barracks. At Tobago, where the temperature is not so low as we find it here, the cubic space (in barracks) allotted to each man was only 220 feet. We need not be surprized that the mortality of the troops under such conditions ranked very high. I had the honour to serve for eight years in the Guards, and when I joined we had a building as a barrack in Hyde Park which still stands. That building—I dare not call it a barrack—consisted of two houses: one of them was occupied by a storekeeper; the lower floor of the other by a guard for the powder magazine at Kensington Gardens, and the upper floor as a barrack for a company of the Guards. To find room we could not afford to put in any iron bedsteads, but there was a guard bed down each side of the room with the palliasses touching each other. Above these, and half way between the floor and ceiling, was another set of beds arranged in the same manner, and as these did not afford sufficient accommodation a row of palliasses was put down on the floor of the centre passage between the two rows. Is it any wonder that the Guards lost a large number of men from phthisis? I think not. This very unsanitary arrangement was brought under the notice of the authorities. The storekeeper and the guard were turned out, thereby obtaining four times the amount of accommodation for the soldiers, and even then it was considered that the men were too crowded. The Tower was very little better. Fortunately for this country a fire burnt down the armoury in the Tower and destroyed 112,000 old useless "Brown Besses" which were being converted into percussion muskets. A barrack was built upon the site of the old armoury, and when we came to take possession of it some objection was made by the barrack master, because he had put into the new structure a quantity of barrack stores; and when it was suggested that he had better put them into the old barrack we were informed that the old rooms were much too damp for blankets, but they were quite good enough for soldiers! Fortunately the matter was brought to the notice of the Duke of Wellington, who immediately ordered the new barrack to be given up, and informed the store department that they might put their blankets where they pleased.

I think it necessary to mention this to show you that the improvement did not begin with the present century, for it was as late as 1845 that these two events occurred. Mr. Bell has quoted some statistics with regard to the mortality of the military and civil populations, and I am proud to think that I had something to do with bringing in the measures which resulted in such a satisfactory reduction in the death-rates as he has shown to have taken place. But I think it fair to tell you that I do not consider that these results were entirely due to the improvement of the barracks. Part of the reduction of the mortality came from the system of limited service introduced by Lord Panmure in 1849, by which our army became younger; and I need not tell you that the reduction of the age of the soldiers serving might account for a certain portion of the reduction of the mortality. There is one thing, however, to be said in connection with the improvements which have been effected in the condition of the soldier—that when I first began the work of compiling the statistics of army mortality in 1836 it was, as near as we could calculate, 3 per cent. per annum, taking the army at home and abroad. Since that time we have had a much larger proportion of men in India, and yet with all that, owing to the improvements in the health, the clothing, the feeding and the housing of the soldier, the mortality has been reduced to something under $1\frac{1}{4}$ per cent. In fact we have by the sanitary measures introduced by the military authorities, in accordance with the recommendations in the statistical reports to which I have already alluded, saved 3,000 lives annually in the army. Mr. Bell has mentioned that a very important change has taken place in the construction of barracks—that of having the windows open on both sides of the barrack room. Now that is not quite a new improvement, because I was quartered at Winchester and also at Chichester when I was in the Guards, and in both these barracks, although old barracks, we had windows on each side and we had "through" ventilation. We also had at Winchester the system of false beams across the room, opening to the outer air, so that the barracks there were quite as well ventilated as any of the new barracks. But though we had good ventilation, we had very bad heating. I quite agree with Mr. Bell in the encomiums he has passed upon Captain Galton's stove. I have seen these stoves in operation, and they are the means of introducing an abundant supply of fresh air at such a temperature as ought to be introduced into the barrack rooms for soldiers. I do trust, however, that the War Office is very careful that the air chamber behind the stove, and the valve opening above it, are always provided where the Galton stove is used. When I was in charge at Netley, I found the corridors fitted with Galton stoves, but the authorities quite forgot to put either air chambers behind or openings at the top. I do not know whether the corridors have been improved in that respect. I made a strong representation, but I was removed from Netley before anything was done. Mr. Bell has alluded to the difficulty connected with the ventilation of soldiers' quarters, and I can most fully corroborate all that he has said. When I have had anything to do with ventilation for soldiers I have found an attempt on their part to stop it up. A soldier can never be too hot. I have seen soldiers in the hottest weather unfold their great coats and put them over the bed clothes on purpose to keep themselves warm; and the only mode in which the ventilation can be thoroughly carried out is to put it under the charge of a non-commissioned officer, and hold him responsible that it is not interfered with without the sanction of the superior officers. I do not know at what period the improvement in the stables was introduced into this country, but I do know

that the mortality of the horses is only two per cent., whilst in the French army it is close upon three per cent. I believe the best thing we can possibly do in building stables is to ventilate them thoroughly. We cannot introduce Captain Galton's stoves, but we can give the horses more air and an additional blanket. It is much safer for a horse to have abundance of fresh air by placing him in a well-ventilated stable with additional clothing than to stop up the ventilation and keep him warm by the emanations from his own body. I am quite sure that one of the causes of glanders being so prevalent amongst the cavalry horses of the French, compared with those of the British army, is the great want of ventilation in their stables—and I believe it is since they have begun to ventilate their stables, they have reduced the mortality among the horses from glanders. Some years ago when I was in France, and also in Italy, I took the opportunity of visiting the barracks and stables of a number of the troops there, and I fully agree with Mr. Bell in all that he said in regard to the excessively bad construction of the Continental barracks. The best I saw were in Paris—the barracks of the Garde Municipale. In Italy I visited some of the hospitals, notably in Florence, and found in one of the large military hospitals that, owing to construction and consequent want of proper ventilation in the wards, they had outbreaks of erysipelas and pyæmia. The only ward which they considered a healthy one was one in which a large hole was made in the wall and which had never been filled up. In that way the ward was well ventilated, and for serious operations patients were removed there from the other wards. I think this view of the necessity of good ventilation in a hospital is borne out by what occurs to troops on active service. When they have been obliged to put up with such accommodation as they could get in sheds and the like, where it was impossible to check ventilation, they have been remarkably free from pyæmia, but whenever they have been put into old convents and such buildings where the ventilation was defective, the mortality has always been very great. I can only urge in conclusion the great importance of ventilation. [The CHAIRMAN asked Dr. Balfour to give some information about the hollow ventilating beams in Winchester barracks.] At Winchester the hollow beam was carried right across the room, and the lower surface looking towards the floor was perforated with a number of holes. When we took possession, the men complained very much of the draught of cold air coming down upon their beds, and stopped up the holes with rags and paper. I had the holes unstopped and covered with brown paper instead, to a line corresponding with the foot of the men's beds; there was no further complaint of draught, and the space between the two rows of beds was quite sufficient to admit abundance of fresh air into the room.

THOMAS PORTER, *Fellow.*—Perhaps I may apologize for a few moments occupying your time, as I once spent a few months in the War Office at Portsmouth, and had then the opportunity of seeing something of barrack construction. Having looked round the walls to-night at the various drawings, I must confess I cannot think that the architectural treatment of barracks (with the exception of those at Inverness) has very greatly improved. They seem to be almost as difficult subjects to treat architecturally as dwellings for the working classes, which up to the present time have not in this respect been often very successfully handled. I was very much struck with the statement of Mr. Bell as to the cost of barracks, and I cannot understand how such plain buildings can cost £200 per man. Mr. Barry spoke of 5½d. a cube foot being a very low price. I think it will be found, however,

that our large public rooms, where there is a great deal of architectural ornament, would not very largely exceed that amount, and that 5½d. will be found to be really a heavy cube, and that it will be quite impossible to make a building cost £200 a man, and working out at 5½d., without finding that it must be a high rate per cube foot. The size of the rooms must certainly be taken into consideration. With regard to the internal linings of the walls, I could not gather from the author of the Paper that anything like a glazed brick, or expensive cement was used, but I think they were said to be merely lime-whited. Nothing could, therefore, be cheaper than their treatment. With regard to the ventilation, which is said to be so very perfect, I have every confidence in Captain Galton's stove. It is an excellent one, but I think the author of the Paper rather slurred the question of ventilation. I could not gather much was done about it, save the introduction of Captain Galton's stoves, and with regard to the treatment of the windows especially nothing was said. I do not know how they are treated. I imagine they are plain sashes. We should like to have heard a little more of this, for it is rather an important point in the question of barrack construction. There was one other point that the author did not state, but I gather that there is a lavatory in connection with all the bedrooms. I suppose there are baths in some parts of the building, and that they are used every day. With regard to the inner lining of barrack walls, it is worth the hint whether the modern enamelled brick which has been used, I believe, so successfully in the Children's Hospital might not be adopted with great advantage in a barrack room.

E. C. ROBINS, F.S.A., *Fellow.*—I should like to say that I have felt very much interested in the Paper, and in its various details given so clearly by its author, and in such a way that they may be used by others who desire to erect buildings of the same class. He has not gone much into the question of ventilation, and I should like to ask him whether in fact the extract shafts, which he mentioned as being placed in every wall, include any means of enforcing an extraction by heating the upper strata of air into which those shafts may enter, whether they go down or up, or whether there is any central shaft into which they are brought together, heated at its base to form a vacuum, and thus to increase the power of the current in the flues? I should like also to know whether any other stoves than those of Captain Galton have been used in these buildings? That is the only stove that has been mentioned. In some cases these stoves have answered very well, in others they have not. Where such bad construction exists, as has been referred to, of course it is different. In reading lately some of the works of those medical officers who have been associated with the army in the consideration of all those questions which refer to the health of the army, and the buildings in which the army is located, I have been struck with the great care with which they have gone into such matters as ventilation, drainage and sewage. Many of them were scarcely mentioned in the Paper, and I have felt we are very much indebted to the medical men to whom I have referred for the way in which they have expressed their views—I refer particularly to Dr. Parkes's work on Hygiène, edited and enlarged by his successor Professor De Chaumont—which prove that the officers in association with these gentlemen must have received very great benefit from their researches. Looking at these buildings from an architectural point of view, although we may regret that we are not more employed in working them out, yet whenever we are, it cannot but be a great gratification to receive such clear instructions as are usually given in such cases. The military officers are well up to their work, and the medical officers well know also what

they require. Hence the instructions given are, and indeed must be, much more complete than the instructions we commonly get in reference to any other buildings. Therefore I think there will be a larger amount of the architect's attention capable of being set free, to be given to the consideration of the artistic effects he may be able to produce, because he would have considerably less to consider in working out the practical details in consequence of the full instructions that he would receive.

WILLIAM WHITE, F.S.A., *Fellow.*—I should like to say a word as to an extraordinary fact, not so much that a new barrack should have cost £225. per man, but that the old scale of barracks should have cost only £12. per man. It is a thing perfectly incomprehensible, even when you allow only a third of the amount for the price of brickwork—£5. per rod then to £15. per rod now. [A MEMBER here stated that there were four men in each bed.] This is fairly and literally twenty times as much. One man costs as much now as twenty men did at that time, and it requires a little explanation. I have no doubt Mr. Bell will be ready to give it. With reference to ventilation, let me tell you of a breeder of horses on a large scale, who took it into his head to remove the whole of the roof of his stable. He then blocked up the windows, making the walls and doors more secure. I understand that he never had a case of sickness after that which could in any way be referred to anything but an accidental cause. There were no roofs to his stables, but there was a perfect absence of draught. I heard Mr. Rawlinson speaking of his own experience as a man of delicate constitution, and yet retaining his energies to the degree he has. He attributed it to the free admission of fresh air. He always slept with his window wide open, but he took the utmost precautions to secure himself from draught and his body from chill. He had special clothing made, and since he had adopted that rule he had enjoyed a wonderful immunity from cold. I would ask Mr. Bell before this Paper is printed to go over again this question of the cost, because it is a very remarkable thing if you look at it. It is £225. per head, and taking the wards at 720 cubic feet per man (say with the walls 820) at 6d. (instead of 5½d. to avoid fractions) a foot, it works out at eleven times as much as each bed ought to cost. My mathematical powers are quite at fault, and indeed I am utterly perplexed by it.

The CHAIRMAN.—The only Paper which I think is at all to be compared with Mr. Bell's Paper in its completeness is one in the *Encyclopædia Britannica,* under the initials "C. B. E.," and which I have very little doubt are those of a distinguished officer in the Royal Engineers. But space would not of course allow that author to treat the subject in so exhaustive a manner as Mr. Bell has done. With respect to the cost of one of the barracks alluded to, viz. Chelsea, which certainly does appear to be extremely high, I can throw some little light, as I was in communication with the architect, Mr. Morgan, at the time it was being built, and he was kind enough to give me the particulars as to the foundations, which were some of the most difficult and costly that I remember. Half of the long range of building was built upon a very fine piece of gravel, and the other part was upon the old bed of the river, and Mr. Morgan told me that he had driven a pile 60 feet without finding a firm bottom. Piling was abandoned, and the architect was obliged to use an enormous mass of concrete, in order to crush down the loose wet ground into a solid mass and thus get a foundation. Of course you know that in such a case a very heavy extra expense is incurred, quite inappreciable to the eye, but which tells heavily upon the total cost. Perhaps Mr. Bell, in his reply, will be kind enough to notice one or two questions

which have been suggested in the discussion. Does the 5½d. or the 8d. include the stoves and other fittings? As to the lining of the walls; perhaps he will also say what it is. Then there is the point that Mr. Robins asked about, and one likewise as to the sashes.

E. INGRESS BELL, *Associate.*—Dr. Balfour is quite right in stating that the system of lighting barrack rooms along both sides was in use before the date of the passing of the Military Forces Localization Act of 1872. As a matter of fact some of the Irish barracks of the last century present this arrangement, and consequently, as pointed out in an early portion of my Paper, these barracks were found to be more satisfactory than the majority of those examined by the Commissioners. As to the lining of the walls, it is lime-whiting only on ordinary stock brickwork. With regard to warming and ventilating arrangements, the system is very simple; warm fresh air is admitted from behind the Galton stoves, and is discharged into the barrack room through fixed louvres at a height of 8 feet from the floor. Cold fresh air is admitted through the side walls and between each pair of windows, by means of air-bricks in the outer face of the wall and louvres in the inner face of the wall, and also at a height of 8 feet from the floor. The foul air finds an exit at the ceiling level into an upcast flue, built in the chimney breast and carried up between the smoke flues for the sake of inducing a current. This exit flue discharges into the open air a few feet below the level of the exit for smoke. The windows are fitted with ordinary sashes, double hung. Separate bath rooms are provided for the soldiers, and so far as I am aware Capt. Galton's grates are used exclusively. On the question of cost, the apparent discrepancy between the low cube rate and the high rate per head of accommodation is easily accounted for. The cube rate of course depends on the cost of materials and labour, and the skill with which they are disposed; the cost per head depends upon the extent of the establishment allotted to a soldier and his wants. Under the old system he had a share of a single room, in which he cooked his food and ate it, cleaned his arms, slept, idled away his spare time, and he had nothing more. Under the new system he has a share of a much larger room, in which he eats his meals and sleeps; but he has in addition cook-houses, bath-houses, wash-houses, quarters for married men, schools, gymnasia, canteen, reading and recreation rooms, libraries and such like. Moreover in the Brigade Depôt Barracks the object is to provide a nucleus for recruiting and a centre for the drill of militia; and although the force permanently occupying the quarters is small, the store and other accommodation is on a scale suitable to a regiment or battalion. It is therefore easily conceivable that with a fall in prices the buildings might be erected for 4d. a cube foot, and yet the basis of the Barrack establishment might be further extended and so cost £500. per head. The sums of 5½d., 6½d., and 8d., which I stated to be the cost of various portions of a modern barrack, include everything except furniture. The low cost per cube foot testifies to the skill of the War Department's professional staff. The extent of the Barrack establishment is settled by far higher authorities, and for the cost per head the Works Department is not, therefore, responsible. As to the designs for the Inverness Barracks, the elevations and details of which hang upon the wall, gentlemen present can form their own opinion. All that I sought to do in my Paper was to bring out the contrast between the old insanitary and inartistic treatment of barracks, both in plan and design, and the advance in both directions which has been made during recent years. In conclusion, I have only to thank the members for their patient and courteous reception of my remarks.

Extract from the Report of the Barrack and Hospital Improvement Commission on Ventilation of Cavalry Stables.

[The Commissioners reported 31st October, 1863.]

In constructing new stables the great principle which ought to be kept in view is to have the air moving freely through every part of them, above and around the horses when they are standing, and in all the angles between the floor and walls when the horses are lying down, and every horse should have sufficient ventilation for himself without being obliged to breathe the foul air of his neighbours. These conditions would be most completely obtained in an open shed, such as is used for stabling horses in warm climates, and the nearer we can approach to this construction, keeping in view the necessity for protecting horses in this climate, while at rest, from extreme cold and cold blasts of wind, the healthier will be the stable. There are certain forms of construction which are precluded by this principle, and which ought not to be repeated in future stables. The worst of these is the old construction we have described, of placing the men's rooms over the stable space, and dividing the space transversely by walls into a number of separate stables having each two rows of horses with their heads to the division walls, and the windows and doors at the ends. The most cursory examination of such a stable is sufficient to show that only the four horses in the corners can be supplied with fresh air under the conditions we have pointed out. All the others have very foul air to breathe. We beg to recommend that this method of construction be in future abandoned, as inconsistent with ventilation and health. All existing stables of this class can be somewhat improved in the manner we shall recommend, but the construction is so opposed to sound principle that it ought not to be repeated. One of the most important points in our inquiry has been into the effect on its ventilation of placing anything except the roof over the stable. We are aware that there are differences of opinion on this point, but, after careful consideration of the examples of various classes of construction, we have arrived at the conclusion that there is a considerable difference among them in degree of efficiency in the ventilating arrangements, and also in the possibilities of ventilation, and that beyond a doubt that form of construction which affords the maximum of facility for obtaining a free moving atmosphere throughout the body of the stable is the open roof with ridge ventilation carried all the way along. Where the roof of the stable is not open, but flat and impervious, the distance between the effective ventilating openings, whether windows or other apertures, corresponds of course to the breadth of the stable. But with an open roof and ridge ventilation the distance is reduced to one half, while the difference of height above the ground between the ridge opening and the side windows ensures, according to a well-known law in pneumatics, a far more certain and continuous movement of the air than could by possibility take place with side windows above, unless a high wind were blowing. For the same reason that the best ventilated and most healthy barrack-room is a hut ventilated along the ridge, a stable with ridge ventilation is the most healthy stable. A flat impervious roof, a hay loft, or a barrack-room over a stable increases the difficulties of ventilation. Our object being to obtain the best possible ventilation for stables at the least cost, we cannot do otherwise than object to any of these constructions. As already stated, where such exist, the ventilation can be improved by methods we shall afterwards suggest, but in future the structure should be avoided. In so far then as concerns the general movement and renewal of the mass of air in a stable, the form of construction which effects this most easily and efficiently is an open-roofed stable, with ventilation along the ridge, swing windows along the sides, and a continuous inlet for fresh air under the eaves made of perforated brick, so arranged as to throw the entering currents up towards the roof. A great incidental advantage of the open roof should not be overlooked, and that is the facility with which it enables the stable to be thoroughly well lighted. Light is in its place as essential to health as air, and moreover, when introduced vertically from the roof, it enables the state of cleanliness of the stable to be seen at once, while the conduct of every man in the stable can be seen from a considerable distance. These advantages struck us forcibly in comparing the different classes of stables. Stables without open roofs have no natural means of renewing the mass of air in the stable, except by opposite windows or doors, or by apertures made in the walls. When these are properly used, and when a wind is at the same time blowing more or less directly against the side wall of the stable, the air within can no doubt be kept in a certain state of wholesomeness. But if there be no such wind there will be always more or less stagnation, on account of the distance between the opposite windows and doors. The simplest and least expensive way of diminishing this risk is by carrying foul-air shafts from the ceiling of the stable up through the apartments above, and so to the roof. When these shafts are properly made, the action of the law of difference of temperature occasions a more or less constant movement upwards, to compensate which fresh air enters the stable, and so the amount of stagnant air is diminished. We have examined a number of stables in which these shafts have been introduced. The state of the air we found to be better in

some than in others, and much better no doubt in all than it would have been in the absence of the shafts; but the results generally show that it is a mistake to construct stables on a plan which renders such shafts necessary. There is no doubt an additional movement of the air effected by them, but it is questionable whether any practicable size of shaft would ventilate such stables sufficiently. The results rather tend to show the bad character of the construction of the stables. As regards light hardly any of the close-roofed stables are sufficiently lighted. Some are better than others, and the best lighted are those which contain the smallest number of horses, and have the greatest height on account of the windows permitting the light to fall at a higher angle. But they are all very much inferior in this respect to open-roofed stables partially glazed. Besides providing for free movement of the mass of air within the stable, it is necessary in all stables, but in some much more than in others, to supply fresh air near the ground level at the head of each stall, so that the horse may have fresh air to breathe when he is lying down. The reason of this necessity is that in all stables the stratum of air next the floor level is the most impure, and will always be the most impure under any improved conditions of drainage and paving. Besides this, the horse, in lying down, places his head close to the angle between the floor and the wall where the air is stagnant. The necessity of providing a slight air current at this angle has been recognized in recent stables, otherwise of a defective structure. It is done by a shaft in the wall carried from end to end of the stable, and communicating at both ends with the outer air. There is an air brick with a sliding cover communicating with this shaft for each stall, at 6 or 8 inches from the ground, through which the air is admitted. We propose to extend this improvement to existing stables by having a shaft carried from outer air to outer air under the cribs. In all stables where the horses' heads are not placed against the outer walls, these shafts should have at least double the section per horse of those at present in use for transverse stables. In stables where the horses' heads are placed against the outer wall these horizontal air shafts would not be necessary; simple openings, and air bricks in the outer walls, would be sufficient. Perhaps the best place for these openings would be between the stalls, where they would be less likely to occasion draughts on the horse during high winds. They should consist of small perforated bricks, or of bricks so made as to throw the air current downwards to the floor. Two or three such bricks in line would be sufficient for each stall, and they should be placed about 6 inches from the floor. In stables with the horses' heads to the outer walls one such brick per stall would be sufficient. It is an incidental advantage of this method of arranging the stalls that it admits of greater facility of this under-ventilation than any other form of stable. . . . . . . As already stated, two arrangements of stalls exist in the troop stables having open roofs. We have carefully examined these, with the view of estimating their relative advantages. In all these open-roofed stables, except in one at York, a partial wall is carried along the stable exactly under the ridge, and the heads of the stalls are placed against this middle wall, leaving the hind quarters of the horses towards the outer walls of the stable, with a passage about 7 feet broad between the stalls and the wall. It was stated to us that this arrangement had been adopted for greater safety from injury, which is presumed to be less with one row of horses than with two. It occurred to us, however, that if the horses' heads had been turned to the outer walls the same breadth of stable would have enabled a passage 14 feet wide to have been obtained between the opposite stalls; an arrangement which would apparently have ensured greater safety than the other. We propose that 14 feet be allowed as the breadth of one central passage, not only because of its greater safety, but because of the larger superficial area per horse, and the greater facility for stable work which it affords. The central wall also interferes to some extent with the free ventilation of the stable, by obstructing more or less the movement of the air across it, while it makes no provision for introducing fresh air near the floor for the use of the horse when he is lying down. It would be more difficult and costly to introduce such a fresh air supply in stables of this construction, because the central division wall has a passage between it and the outer end walls of the stable, and the only way to meet the difficulty would be to carry an air shaft under the end passages to the wall, and then along the wall. The usual openings for each stall would have to be made from the air-shaft. If this class of stable is to be extended this point would have to be looked to in new plans, and it would be very desirable to carry a course of perforated bricks all round the outer wall a few inches above the ground, and a similar course all round under the eaves. It struck us that stables with these division walls were not so light as the open-roofed stable at York, having the central passage. There is a great difference also in the facility of supervision afforded by the two classes of construction. The open-roofed stable, with its light central passage, enables every horse and man to be seen at a glance, which is certainly not the case with the other form. Both stables are good, and either of them is a great advance on any other existing form of construction, so far as concerns their ventilation; but that form of construction which appears to us to combine the greatest facilities for effective ventilation, with light, facility of supervision, and economy, for troop stables, is the open-roofed stable with the central passage. We beg to conclude this part of our report on the form of future construction

of troop stables best adapted for preserving the health of horses with the following recommendations: 1. That the old transverse arrangement of stable be discontinued. 2. That in future all troop stables be built with open roofs and ridge ventilation from end to end. 3. That the roofs be partially and sufficiently glazed to afford plenty of light. 4. That in so far as concerns facility of ventilation and supervision, the open-roofed stable, having a central passage 14 feet in width between the stalls, is preferable to the open-roofed stable with a centre division wall and two passages, each of half that width. 5. That besides ridge ventilation and light, each stall should be provided with a swing window over the horse, and a row of perforated bricks should be carried round the stable under the eaves. 6. That each stall should have a supply of fresh air introduced in the space between the stalls, about 6 inches from the ground through perforated bricks. 7. That improved impervious paving be introduced. 8. That all drainage within the stable be carried away in shallow impervious open drains by a rapid slope to the outside of the stable. Covered drains and cesspits within stables or near the stable walls to be discontinued.

Extract from a Paper on Vital Statistics of Cavalry Horses, read before the Statistical Society, March 16*th*, 1880, *by Surgeon-General T. Graham Balfour*, M.D., F.R.S.

The information respecting the horses of the army serving in the United Kingdom is unfortunately very meagre. It is chiefly to be found in the "General Annual Return of the British Army," prepared by the Adjutant-General and presented to Parliament. This return shows the strength, deaths and numbers cast in each year from 1861 to 1878 inclusive, but gives no information respecting the causes by which the mortality and casting have been occasioned, nor the ages at which they occurred. The aggregate strength for the eighteen years 1861-78 amounted to 246,856, the deaths to 5,202, and the numbers cast to 24,014, being in the proportion of 21·07 and 97·79 per 1,000 of the strength annually. If the period be subdivided it will be found that there has been a slight increase in the mortality, but a very marked decrease in the casting during the last eight compared with the preceding ten years:—

	Aggregate Strength.	Died.	Cast.	Ratio per 1,000 of Strength.	
				Died.	Cast.
1861-70	129,324	2,647	14,210	20·47	109·88
'71-78	117,532	2,555	9,804	21·74	77·26
Total 18 years . .	246,856	5,202	24,014	21·07	97·79

The mortality ranged between 16·87 per 1,000 in 1864, and 28·15 in 1871, and the casting between 75·71 in 1871, and 156·12 in 1878. It will be observed that the year in which the mortality was highest was that in which the casting was lowest. Unfortunately we have no means of tracing the diseases in which these differences occurred, nor of ascertaining the influence of age on the death-rate. If the results for 1861-70 be compared with those of the French army for 1862-66, it will be found that in the British army the rate of mortality has been one-fourth lower, but the casting about one-fourth higher than in the French army. From 1872 the returns give the numbers separately for the different arms of the service, of which the following table shows the results:—

1872-78.	Aggregate Strength.	Died.	Cast.	Ratio per 1,000 of Strength.	
				Died.	Cast.
Household cavalry . .	5,885	90	492	15·29	83·60
Cavalry of line . .	47,307	1,073	3,645	22·68	77·05
Royal horse artillery .	13,025	810	3,006	19·79	73·44
Royal artillery . .	27,906				
Royal engineers . .	2,921	59	191	20·20	65·39
Military train, and army service corps . .	7,558	159	1,489	21·04	197·01
Total 7 years . .	104,602	2,191	8,823	20·95	84·35

It will be seen that the highest rate of mortality has occurred in the cavalry of the line, and the lowest among the horses of the royal engineers; but the numbers are much too small to justify any positive conclusions on the subject. The Household Cavalry had the highest proportion of horses cast, and the Royal Engineers the lowest.

III. SANITARY SCIENCE IN ITS RELATION TO CIVIL ARCHITECTURE.

By Edward Cookworthy Robins, F.S.A., *Fellow.*

[Read on Monday, 29th November, 1880, John Whichcord, F.S.A., *President*, in the Chair.]

NO subject of study can be more useful and honourable than that of the principles which should govern the direct application of Sanitary Science to the development of our national architecture—no duty greater than the recognition of our responsibilities in this matter, and of fitting ourselves for it. The growth of contaminating influences injuriously affecting the healthfulness of the elements, the earth upon which we live, the air we breathe, and the water whereof we drink, is commonly the result of culpable ignorance of the simplest sanitary laws, and the appropriate mechanical appliances necessary to give effect to them. This is generally acknowledged in the abstract, and there are few subjects upon which philanthropists are more ready to expatiate, or more reckless in the adoption of any suggestion which sounds sufficiently iconoclastic or revolutionary.

Those of us who, for the last thirty years, have practically proved our interest in this subject of course cannot be otherwise than pleased to observe the improvement in public opinion, and the quickening of the professional conscience, thereupon. Such men as Mr. Chadwick, Dr. Richardson, Captain Galton, the late Dr. Parkes and many more, are working with us and not against us, and we shall not grudge to them the credit they undoubtedly merit, because the public are less familiar with the names of those architects, who, led by Mr. George Godwin, the accomplished editor of the *Builder*, have fought for long years, through good report and evil report, against the prevailing ignorance and apathy.

The useful and eloquent articles in that newspaper, during the visitation of cholera in the year 1852, first led me to take a personal interest in this question, and ultimately to allow myself to be associated, as Honorary Architect and Secretary, with the Local Board of Health for the parochial district of Regent Square Church, St. Pancras, under the presidency of the Incumbent. In this capacity an opportunity was afforded to me of establishing a precedent for local sanitary exertion, and preventing the spread of disease in that particular locality, which comprized one-17th part of the whole parish of St. Pancras. The result of this experimental inquiry was published in the year 1854, in a pamphlet entitled *A Practical View of the Sanitary Question,* a copy of which I now lay on the table. A thousand copies were printed and circulated throughout the country, and the receipt of one was acknowledged by the late Mr. Tom Taylor, then Secretary of the General Board of Health, as follows :—

> "I beg to acknowledge with thanks the receipt of the Report of the Local Board of Health for the Parochial District of Regent Square Church, St. Pancras, and to express the great satisfaction which the contents of that Report have caused to the President of the Board (Sir B. Hall)—a satisfaction expressed to me in the strongest terms—and to myself, as a record of a most successful effort of local activity, which cannot be too widely disseminated. I should be much obliged if I could be furnished with twelve copies of the Report for the use of this office."

The Commissioners of Sewers asked for sixteen copies of that document, from a perusal of which it will be seen that no less than 1017 separate sources of infection were abolished

by the Board's action.* Two Metropolitan graveyards were closed by special appeal to Lord Palmerston, the then Home Secretary, and assistance was rendered in revizing the Bill to amend the Nuisances Removals Act of 1848-49, at the solicitation of Sir Benjamin Hall, its proposer, a Bill which subsequently became law. That was the period at which the Main Drainage of the Metropolis was under discussion, resulting in the establishment of the Metropolitan Board of Works to carry it out.

As a member of the then Metropolitan Sanitary Association, I was most earnest about the establishment of a corps of sanitary surveyors to be appointed by the Act, as well as medical inspectors, and I was one of a deputation to the Home Secretary on the subject. It was with great pleasure, therefore, that I read the following paragraph in the concluding chapter of Captain Galton's *Observations on the Construction of Healthy Dwellings*:—

"It is the function of the sanitary engineer, or local surveyor, to adopt measures to prevent or to remove those sources of danger to health which the medical officer is called upon to detect. The community does not permit any man to practice medicine without having satisfied a careful and responsible board of examiners that he has educated himself for his position, and education in the principles of Sanitary Science is just as necessary to insure the efficient fulfilment of the duties of a sanitary engineer or local surveyor, as is the study of medicine to the medical man. . . . . . . When the public realize that the progress of the Nation in healthiness is to be attained by a careful attention to these details, they will insist that the local surveyor or sanitary engineer shall have a complete education in the science of the healthy construction of buildings, and in the arrangements for health to be adopted in towns and villages; that is to say, in the conditions necessary for the *prevention* of disease, just as at the present time they require education in those who minister to the *cure* of disease."

Mr. Chadwick is of opinion that the subject of house drainage should be cultivated as a speciality, and he attributes to our professional negligence many existing evils. Sanitary science is indeed not so old but that architects of the last generation may be found often as ignorant of sanitary law as were their medical contemporaries. I readily admit that the education of an architect is incomplete when he allows his mind to be so absorbed by the artistic side of his profession as to look with contempt on the practical. It is true that the architect is *par excellence* an artist, and his works should take their stand among the fine art memorials of his age; but the arts of construction are important means to that end, and are to him what

* "The Local Board of Health owed its origin to the exertions of the Incumbent of Regent Square Church, the Rev. Geo. Albert Rogers, who invited a few benevolent individuals, being members of his congregation, to unite themselves with him for the purpose of remedying the sanitary evils existing in the district. The following are the names of those gentlemen who were invited by the Incumbent to attend the first meeting held at his house on the 18th of October, 1853 :—Rev. J. Hilmer, J. E. Clowes, Esq., Dr. Sawyer, J. Nokes, Esq., Henry Raven, Esq., J. A. Russell, Esq., Chas. Wyman, Esq., Mr. Brown, Mr. Genever, Mr. Thomas and Mr. Westbrook. Several other gentlemen of the district were afterwards associated with them, and ultimately the Ministers of other congregations included therein ; the object being to make it as much a district matter as possible. Their first care was to ascertain the real state of the district in a sanitary point of view. The City Missionaries, Messrs. Genever, Brown and Thomas, assisted most energetically in obtaining this information by means of a house to house investigation, noting down from the lips of the occupants and from their own observation the various annoyances to which they were subjected. From the reports of the City Missionaries, Mr. Robins and Mr. Russell drew up a statement showing the then present state of the district, and the great need that existed for some interference on behalf of the poorer classes. This statement was printed and circulated among the higher class of residents throughout the district. The Incumbent also forcibly appealed to his congregation to support the Board by their liberal contributions, and on three successive Sundays he appropriated to its funds the collections made in the boxes at the church doors, which, added to subsequent donations, enabled the Board to proceed to the appointment of an Inspector, and from his appointment the aggressive operations of the Board commenced."—*Extract from* "*General Report*," *November*, 1854.

anatomy is to the figure painter. It is equally true that the engineer is *par excellence* a constructor, and not necessarily a man of taste at all. The grand effects produced by the vastness of the structures he designs are commonly fortuitous and not the distinct aim of the designer; their beauty (if any) is that which grows out of the fitness of things, the perfect adjustment of the means to the end desired, in the absence of which conditions real beauty is non-existent, and like faith without works is dead.

One good result which might have been expected to issue from the temporary cessation of the battle of styles amongst us, consequent upon the benign influence of good Queen Anne, was the increased study of comfort and convenience irrespective of eclectic considerations, the element of picturesque grouping atoning for all irregularities in design. Certainly design is now unfettered by symmetrical rules of sentimental proportion or balance of ornamental associations either of gothic or classic origin. It is well that the public should understand this, and be able to rest content that, when an architect is employed to build a house, it will not be necessary to call in the sanitary officer in order to be sure that it is properly lighted, heated, drained and ventilated. I do not say that this has never been necessary, for I cannot forget how the artistic nature of a late popular and justly esteemed young architect rebelled against the prosaic duties of the hour. Once when I was with him, a letter came from a client complaining of some defective piping, &c. "Pipes," said he, "what do I know about pipes, let him send for his plumber." But this indifference is becoming less every day.

British Sanitary Archæologia has yet to be satisfactorily compiled. Prior to the Great Fire of London, no provision was made for the conveyance of the storm waters by underground sewers, and the waters found their way to the river by natural means. In the Act of 19th Charles II. for rebuilding the city, the City Commissioners of Sewers were first appointed, but they were intrusted with this power for seven years only. By an Act in the 7th year of Queen Anne, they were made perpetual. It is to be regretted, however, that the storm waters were ever mixed up with the house drainage. In 1834, a Civil Engineer stated, before a Parliamentary Committee, that when in the previous year some French engineers were sent over to England by their Government nothing seemed to attract their attention more than the sewers of London, the drainage of Paris being then under consideration. Their ideas of the proposed drainage never extended to more than taking away the surface drainage, and they seemed astonished when he told them that the water from our lowest cellars drained into those great sewers. The state of Paris before the Second Empire is known to many here, the foul drains that ran upon the surface of the ill-paved streets, and the abominable stenches, everywhere proved the want of sanitary reform; and Paris is still anything but sweet.

Illustration No. 4 is the copy of a design for draining Paris, projected by the architect, Patte, and published in the year 1769. A vast sewer in the centre of the road is ventilated by vertical shafts over it, and has ledges on either side, above the springing of the lower semi-circular inverted arch, for the carriage of water pipes. The road gullies, house wastes, water-butt overflow and water-closet soil, all descend direct to the sewer. The description will be best given in Patte's own words:—

"La propreté des villes s'est toujours exécutée le plus maladroitement, par rapport à la salubrité de l'air. Je ne connais dans l'antiquité que les Romains qui aient fait des efforts, pour opérer avantageusement le nettoiement des rues : encore y furent-ils nécessités par la position même de Rome, qui comprenait dans son enceinte sept montagnes. Dans l'impossibilité d'étendre leur ville au milieu des vallons qui formaient autant

de ravins, ces peuples furent contraints de pratiquer pour reçevoir les eaux, ces cloaques ou aqueducs souterrains dont on voit encore aujourd'hui des ruines [ce n'est pas qu'on n'ait construit des égoûts souterrains sous une partie de plusieurs villes ; à Londres entr'autres, il y a quelquefois un égout des deux côtés des principales rues, le long de chaque trottoir. Mais nulle part on ne les a disposé de manière à ne point infecter les rivières dans leur trajet à travers des villes ; jamais ils n'ont eu pour but que de reçevoir les eaux des ruisseaux ; et aucunement d'opérer le nettoiement des rues, le transport de leurs ordures, et de faciliter les réparations des tuyaux de conduite], et desquels ils se servirent en même temps avec avantage pour l'écoulement et le transport de toutes les ordures. Ces cloaques ne parcouraient pas toutes les rues, ils étaient seulement distribués dans les lieux les moins élevés de cette Capitale, et venaient tous se rendre dans un autre beaucoup plus grand, appellé *cloaca maxima*, qui se débouchait dans le Tybre entre le mont Aventin et Palatin. On avait réuni sept sources ou sept ruisseaux dans de vastes réservoirs, qu'on lâchait fréquemment dans ces voûtes souterraines, pour les nettoyer et entraîner successivement tout ce qui y avait été jeté. . . . .

"Il ne s'agirait que de saisir l'esprit du procédé des anciens Romains, et d'appliquer à la totalité d'une ville, ce qu'ils firent pour opérer la salubrité d'une partie de la leur ; c'est-à-dire, qu'il n'y aurait qu'à pratiquer sous toutes les rues, des aqueducs souterrains, capables non seulement de servir aux transports des ordures et à leur écoulement sans embarras, mais encore d'assurer la solidité des conduits et de favoriser leur entretien. Voici comme j'imagine que l'on pourrait opérer la réunion de ces différents objets : Ce serait de placer sous le milieu des rues, à cinq pieds au-dessous du pavé, un aqueduc soûterrain d'environ six pieds de largeur sur sept pieds de hauteur. On assurerait la solidité, en construisant sa partie inférieure en forme de voûte renversée avec des claveaux de grès ou de pierre dure, et en faisant sa partie supérieure aussi voûtée, soit en pierre de meulière, soit en petits moellons de roche avec des chaines de pierre dure, de douze pieds en douze pieds. . . . D, (*see illustration No.* 4) fait voir en profil toute sa construction. . . . .

"À droite et à gauche, et à quatre pieds du fond de l'aqueduc, on pratiquerait deux banquettes F, F, en saillie, d'à-peu-près quatorze pouces de largeur, sur lesquelles seraient placés deux tuyaux de fer fondu 5, 6, qui conduiraient les eaux des différents réservoirs, provenant soit de la rivière, soit de diverses sources, dans les fontaines publiques, et dans les maisons, à l'aide de petits conduits de plomb, soudés aux gros tuyaux vis-à-vis des endroits en question. . . . .

"Il est évident qu'à l'aide de notre arrangement, il ne serait plus besoin, pour faire les réparations des tuyaux, de dépaver les rues et d'embarrasser la voie publique. Par dedans l'aqueduc souterrain, on remédierait avec facilité à tous les accidents qui surviendraient. . . . .

"Par le moyen de nos aqueducs souterrains, il est encore aisé de réformer les fosses d'aisance qui causent dans les maisons d'une ville une infection journalière, et empestent tout un quartier quand il s'agit de les vider. Il n'y aurait qu'à établir toujours les latrines au rez-de-chaussée, et tenir leur fosse peu profonde en forme d'égout : alors en plaçant dans le fond un tuyau assis solidement, et disposé en pente vers l'aqueduc, les matières y seraient conduites à mesure. Dans l'intention de précipiter leur écoulement, il faudrait faire en sorte de diriger à travers les petites fosses en question, toutes les eaux d'une maison, celles des toits, celles qui proviendraient des cuisines, celles des cours et autres. Par ce procédé ces endroits seraient sans cesse lavés. . . . . . Il est à observer que l'issue des tuyaux de ces fosses dans le cloaque serait placée dans le socle des banquettes qui portent les conduites d'eau. . . . . On voit dans la Planche (*see illustration No.* 4) le profil d'une latrine : S est le siége ; T est la fosse ; X est le tuyau destiné à conduire les matières dans l'aqueduc, lequel est assis sur un petit massif de maçonnerie ; V est un petit réservoir occupant le dessus des latrines, lequel peut être rempli naturellement par les eaux des toits, à l'aide d'un tuyau de communication avec celui de conduite, &c. Cette eau servirait à lacher successivement dans la fosse T, pour précipiter l'écoulement des matières. Enfin, Y est un tuyau destiné à diriger l'eau de la cour à travers de la fosse."*

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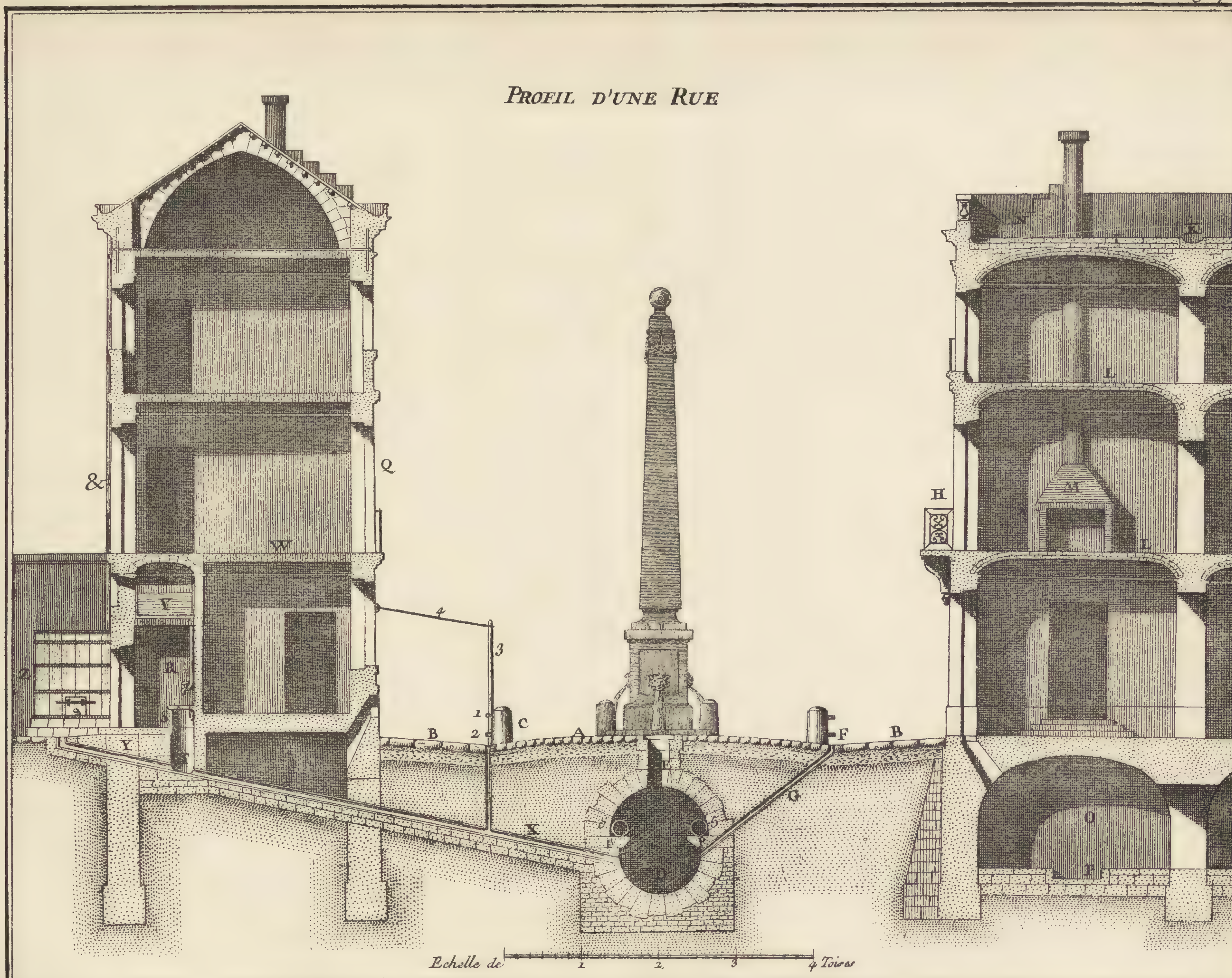
* See Chapter I, "Considérations sur la Distribution Vicieuse des Villes, &c." in the *Mémoires sur les objets les plus importants de l'Architecture. Par M. Patte, Architecte de S. A. S. Mgr. le Prince Palatin Duc régnant de Deux-Ponts.* Paris, 1769.

Further references to the illustration, not mentioned above, are—"B, B, Chemins le long des maisons pour les gens de pied, séparés chacun de la chaussée par un ruisseau, F. C, Bornes placées près des ruisseaux en deça de la chaussée, pour mettre les habitants à couvert de tout accident de la part des voitures ; 1, 2, colliers de fer, dans lesquels sont passées des perches, 3, pour soutenir une banne, 4, de toile cirée, lors des mauvais temps. E, Trou en forme de puits, pour recevoir toutes les ordures des rues. G, Direction d'un des conduits des ruisseaux dans l'aqueduc. Z, Fontaine domestique destinée à rassembler l'eau de pluie pour la boisson. &, Tuyau de conduite dirigeant l'eau des toits vers la fontaine, pour la remplir quand on le jugerait à propos."

SANITARY SCIENCE IN ITS RELATION TO CIVIL ARCHITECTURE. (Nº 4.)

Pl. II. Pag. 70.



C. F. Kell, Photo-Litho. Castle St Holborn, London, E.C.

PHOTO-LITHO. OF PATTE'S DESIGN FOR DRAINING PARIS, A.D. 1769.

DRAINAGE, &c. There are two distinct systems of sewer construction, broadly distinguished by the phrases, *sewers of deposit* and *sewers of suspension*, both having reference to the water carriage of excrementitious matter. The former is adopted in many great towns, and does not necessarily provide for the immediate removal of the soil from houses except in times of storm or very wet weather. At other times a system of flushing more or less intermittent is involved, owing to the absence of sufficient water for the carriage of the soil accumulations and refuse. The latter is adopted in some provincial towns, and requires the removal of the soil at once at all times of the year, or at the very least before the solid matters in suspension have had time to enter into that putrid state when sewage gases of a most deleterious character are generated within the sewer. Obviously the former system is one which by providing for occasional storm waters, or heavy rains, over a large surface of land, as well as the ordinary house sewage, necessitates the construction of vast cavernous sewers, which in dry weather, from the absence of adequate rain-fall and of sufficient flushing arrangements, constitute sewers of deposit, the emanations from which are often so deadly, owing to the insufficiency of ventilation, that disease and death are pent up within them, ready to find a way through every aperture into the dwellings of rich and poor alike, so that the prince and the peasant are equally endangered by living in houses or hovels whose drains are in direct communication with the sewer, unless those precautions are taken which it is the business of Sanitary Science to discover and to enforce. Only recently in the City of Paris it was reported that five men were killed outright through entering an insufficiently ventilated sewer—simply poisoned by the malaria. The latter system is one which provides a separate sewer for the storm waters, or leaves them to take care of themselves and find their own way into the rivers and the sea, and thus necessitates the conduct of the house drainage only in comparatively small pipes, the smallness of the bore concentrating the stream of water which carries with it the soil held in suspension along the narrow channel provided. The constant flushing of such sewers is an easy matter, and an example of its apparent success as a system has recently been the subject of rejoicing at Memphis in the United States of America, concerning which it may suffice to say that designs were prepared on both systems, the first providing for the storm waters with sewers from 1 ft. to a 7 ft. outlet main. The second design, which has been adopted, has pipes only ranging from 6 inches to 20 inches at the outfall. 3000 feet length of 6-inch sewers communicate with 8-inch branches falling into 12-inch aud 15-inch sewers, meeting and ending in the 20-inch outfall pipe. At the head of each line of sewers is a Field's flushing tank, from 120 to 150 of which will flush the sewers daily or twice a day with 100 gallons of water at each automatic discharge. In connection with this system are 4-inch house drains, on the back drainage plan, no drains being allowed to pass under a house.

It is well known that in London a system of sewerage prevails which, despite many excellencies as a scientific work of modern engineering skill, nevertheless entails the necessity of recognizing the insanitary condition of the main sewers, aggravated of late years, not merely by the increase of the population but by the fact that, simultaneously with the construction of these sewers, cesspools were abolished, and all solid as well as liquid matters now find their way into the main sewers. This condition of things, resulting in the conduction of sewer air into the dwellings of the people, affects not merely the air but the cistern water supplied to the houses; and the architect has further to consider what may be the effect on the

health of those who drink the water thus impregnated with a poisonous gas, considerations which necessitate special contrivances to prevent the possibility of any contamination of the air, or of the water, by the emanations from sewers or from foul house drainage.*

We may now consider:—1. The common defects in sanitary construction. 2. The remedies generally available.

To describe in very great detail defects in sanitary construction is not now necessary;

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* The following Extracts are from a Report upon the Metropolitan Sewers, made by Mr. Edward Monson, Assoc.-M.Inst.C.E., for the information of the Society of Arts:—

"In accordance with your instructions, I have made inquiries intothe condition of the metropolitan sewers, and beg to report that I find the subjects given me for inquiry are so large that I have been unable to deal with the whole metropolis. . . . . The subjects given for investigation are:—First, as to the extent of the existence of sewers and drains of deposit in the metropolis. Second, their effects in the development of the gaseous products of decomposition. Third, the mode of cleansing the sewers. Fourth, the defects in sanitary science and art evinced in their construction and working.

"I.—From the inquiries I have made, extending over a period of twelve months, I find that the sewers of the metropolis are, in many cases, sewers of deposit, and not constructed on the self-cleansing principle. In proof of this, I need only point to the fact that a great number of men are required by the Board of Works and the various Vestries to keep them open and in working order. The low-level sewers are constructed at a level sufficiently low to pass under the existing outfall sewers; they have no available outlet, except by pumping. In point of fact, they are not sewers at all, but sewage tanks, adits, or reservoirs, and hold the supply of sewage for pumping. They are the sludge chambers of the district and receive the filth of the adjoining parishes. They are elongated cesspools and unquestionably sewers of deposit. Not being in duplicate, and having no outlet except by pumping, they are never entirely emptied. The sewage thus becomes putrid, and the offensive smell from these sewers is the subject of frequent complaints. . . . . In some places the old flat-bottomed sewers, originally constructed for surface water and rainfall have been utilized for the conveyance of sewage. These sewers, as a rule, are not self-cleansing, but sewers of deposit—a natural consequence of the sewage being spread over a wide surface and retarded by friction. . . . . Again, some of the large old sewers are not self-cleansing, but sewers of deposit. A flusher has told me of a case where, from subsidence or otherwise, the sewer bottom is not regular, and the sludge lays in pot-holes, to the depth of a foot or eighteen inches. . . . . Some of the smaller sewers belonging to the Vestries are not self-cleansing, and being inconvenient to work in, and difficult to inspect, they get neglected.

"II.—Sewers of deposit mean the decomposition of putrid matter, and the constant formation of sewage gas. Sewage gas being constantly formed, it constantly escapes through the ventilators in the streets, and through any untrapped openings. In consequence of the traps being left off, through the carelessness of servants, it is discharged into dwelling houses, and finds its way into bedrooms through the open joints of the rain-water pipes. Again, during a storm, the low level sewers are filled and the sewage heads up. As the sewage rises, the sewage gas becomes more and more concentrated, and if sufficient means of ventilation are not provided, it is forced up the drains and discharged into dwelling houses through the traps.

"III.—The sewers not being self-cleansing, it is necessary to employ manual labour to keep them open and in working order. So great is the deposit, that for the main sewers alone, 130 men are constantly kept by the Metropolitan Board at this work, and the sewers for this purpose are divided into six sections, three on either side of the river. The men are called flushers, and are paid 4s. 6d. a day. They are divided into gangs of about five men. To every gang there is a foreman, and to every twenty men there is an inspector. The open sewers are cleansed out about once a year, the other sewers in rotation, and as required. The sewers are flushed by means of a dam board, which is constructed to fit the sewer, and has a hole in the shape of a V cut in the lower edge. The dam board being fixed, the sewage heads up, and rushing through the aperture in the lower edge of the dam board, stirs up the deposit and separates the drift from the organic matter. The organic matter is flushed on, and at length discharged into the Thames. The drift and other inorganic matter is conveyed in barrows to the man-holes, brought to the surface and used in road-making, or sold to jerry builders for about sixpence a load. My informant says, that 'Vestries are not obliged to construct catch-pits, and slosh is frequently forced down the gullies and into the main sewers to the extent of two or three hundred loads of deposit at a time.' The ventilation of the sewers is by open gratings, and, as a rule, no deodorants are used.

so many pamphlets have appeared, and so many books have been written about them, that a very short summary will suffice. Indeed that summary is provided in a small volume prepared by Mr. Teale, the Surgeon to the Leeds Infirmary, entitled *Dangers to Health,* a book which contains 55 page-illustrations of domestic sanitary defects and their obviation. A grim humour pervades them all. The book is dedicated by the author to his medical brethren, and is intended to afford graphic illustration of the dangers of carelessness in sanitary matters, and to give at a glance to the uninitiated a clue whereby the existence of defects may be discovered and amended. These defects consist not only in those things

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Sometimes there is inflammable gas in the sewers, and, on more than one occasion, it has been fired by the light which the men carry on their heads when at work, and the men have been injured. Recently, at Wandsworth, two flushers were suffocated whilst working in the sewer, owing to a discharge from some chemical works; two gangs of men had previously refused to work in the sewer. The Main Drainage of London has greatly improved its sanitary condition, and given an improved outfall to the low-lying districts; and, whilst the main sewers were being constructed by the Metropolitan Board of Works, the various Vestries and District Boards have spent large sums in the construction of self-cleansing sewers of the egg-shaped pattern. The Vestries also employ flushers to cleanse the old flat-bottomed sewers. In the Westminster district five flushers are employed by the District Board, and they work by day; they are expected to keep the sewers clean and are not paid for overtime. The wages are £1 5s. per week and two pairs of boots per year. Deodorants are used in special cases. My informant says that 'the deposit comes chiefly from the macadam roads. The sewers are mostly egg-shaped, the inverts of the flat-bottomed sewers having been taken out and the sewers altered by underpinning. The gullies are trapped and the sewers ventilated in the middle of the roads. The pipe sewers are kept clean by occasional flushing and may be called self-cleansing. The sewers never head up now and the main drainage is a decided advantage to this district.' In the St. James's district there are about two miles of main line sewers in Oxford Street, Regent Street and Piccadilly, and there is a local sewer over the main line sewer. Three flushers are employed by this Vestry; the foreman has 30s. per week and the others a £1; the hours are from six to half-past five o'clock, and if additional flushing is required it is done by contract. Many of the sewers in this district are 5 feet 6 inches by 3 feet, the Westminster pattern. Upon the inverts of some of these a pipe was formerly laid for the conveyance of sewage, but it became silted up, and the surveyor has had all the pipes taken out and the sewers reinstated. The fat and other stuff coming from the clubs consolidates in the sewers and is a great deal of trouble. There are fourteen miles of sewers, but it is the three miles in the neighbourhood of Piccadilly upon which the men are principally employed, and their work is greatly facilitated by the rats and by the vagabonds who go down into the sewers to see what they can find. This district is said to be much improved by the Main Drainage. A table, showing the various sewers, hangs in the surveyor's office. In the district of St. George's, Hanover Square, the number of flushers employed is six. The wages of the foreman are 25s. and the wages of the men 24s. per week; the hours are from seven to four o'clock. The men work during the day, and it is estimated that they bring to the surface 450 cubic yards of deposit in a year, which is removed at 4s. per cubic yard; it consists chiefly of drift and macadam. The flushers are not troubled with fat in the sewers. The population resides only during the season. There are about 52 miles of sewer, and, as a rule, they have a good fall, but in Belgravia it is bad. They are ventilated in the middle of the streets and the gullies are trapped. The old sewers are of the Westminster pattern and the new ones are egg-shaped. The inverts of the old sewers have been taken out and replaced by inverts of the egg-shaped pattern. There are very few pipe sewers in the district. The Metropolitan Main Drainage has not made it much better, except for the purpose of letting off the rainfall.

"IV.—The disposal of the sewage of London has always been a matter of difficulty, and this difficulty has not been removed by the present system of drainage. The brickwork has been executed in the very best manner, and the pumping machinery is a wonderful specimen of mechanical skill, but still, so far as regards the disposal of the sewage, the works are a failure. It is disposed of by discharging it into the river sludge, and all without any treatment whatever. The damage to the river is at present disregarded, and no account is taken of sewage mud and filth which is being constantly cast upon its banks. The old plan was to store the sewage in cesspools constructed in yards, gardens, and under houses; it was next turned into the Thames, and it is by the present system moved on and turned into the river lower down. The nuisance is recurring. It

for which an architect might be blamed, but in the faulty construction and workmanship of the work done by the artisans employed—defective jointing of bad iron, lead, or stone-ware piping, false levels and bad laying of drains, perverse connections on the wrong side of the traps, contaminations of water supply, ill-supported vertical soil pipes, and the thousand-and-one evils growing out of the want of properly educated and properly trained workmen and foremen. The City and Guilds Institute for the advancement of Technical Education has done wisely by introducing the subject of "Plumbers' work" into the new list of Technological Examinations. Happily such common defects in drainage construction as were, till lately,

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has been removed, but not abated. It will crop up again and again, and this is a grave sanitary defect. We are told that the sewage not only does no harm, but from the improved scour of the river it actually does good. The fact is that the streams, used to flow into the river above bridge, are now passed through the main sewers, and this large body of water being diverted from its natural course, and poured into the river at a new point, produces a scour at the point of discharge, but the soil thus removed is deposited elsewhere along with the filth from the sewage. The works are defective in not being self-cleansing. It must be a wrong system which requires so much labour to keep the sewers open and in working order, and which depends very much for its efficiency upon manual labour. In the intervals between the visits of the flusher, the sewers must be left to themselves, and a deposit must be constantly forming, and the organic matter constantly decomposing and liberating noxious gases which pollute the air. The flushing may be well done and well looked after, but still, with sewers which are not self-acting, these things must happen. If a system of self-cleansing sewers had been constructed (and all main sewers ought to be self-cleansing), so many flushers would not be required, the sewage would not have time to decompose, and the formation of sewer gases would, to a considerable extent, be prevented. The washing of the sand out of the sewage by the flushers is a novel and brilliant idea, but this might be accomplished at much less cost. The drift, which finds its way into the sewer, ought to be excluded, and after it has entered the sewer, it might be intercepted by properly constructed catch-pits. The flat-bottomed sewers might be altered so as to be self-cleansing, and inequalities in the sewers might be removed by reconstruction or lining. The decomposition of the sewage might, to a considerable extent, be prevented by a proper deodorant skilfully applied. The metropolitan system of drainage, in its present form, is not complete. Much has been done, but still there is much to do. The District Boards are fully alive to the advantages of self-cleansing sewers, and in many cases the old sewers have been taken up, and an improved form substituted. The water-courses, which have been most improperly diverted from the river, ought to be reinstated ; the sewage ought to be purified before turning it into the river ; the removal of filth from the sewers, to a considerable extent, ought to be effected by mechanical means, instead of by manual labour. The sewers require to be rearranged, so as to make them self-cleansing. The drainage of London, which is upon the combined principle, provides for only a quarter of an inch of rainfall in 24 hours, but, during a thunderstorm the rain falls at the rate of two or three inches per hour, and at times, steadily, two inches in 24 hours. It will thus be seen that the sewers are totally inadequate to carry off the rainfall, and the lower parts of the district are sometimes flooded from this cause. If the separate system of drainage were even now adopted, the capacity of the sewers for removing excrementitious matter and foul and waste water from the district would be greatly increased. At the present moment, there is a difficulty with regard to the drainage of several towns situate on the banks of the Thames. Some of these towns are intimately connected with the metropolis for drainage purpose ; they have been heavily taxed for drainage works executed within the metropolitan area, and they have a right of drainage into the metropolitan system. In reply to applications for that purpose, they are met with the remark, 'Oh, we cannot take you in, our sewers are not large enough.' Now, such a remark may be perfectly correct if it means that the sewers are not large enough to take in the rain water and the sewage also, but it is not correct to say that the sewers are not sufficiently large to take in the sewage of these towns. The western sewers, for instance, were constructed for this very purpose ; if not, why were they constructed so large? First-class sewers to drain streets are ridiculous. The sewage for the western district at the present time is so small in quantity that if the streams were excluded the pumps would have comparatively nothing to do. If the agricultural drainage and streams were allowed to flow along their natural channels to the river it would reduce the expense of pumping, and the carrying capacity of the sewers for removing sewage proper would be so greatly increased that all the towns along the valley of the Thames might be taken, say, as far as Teddington at least, to the great benefit of all concerned."

existing in Boston, United States of America, and recently illustrated in the Society of Arts Journal, are daily becoming less common in London, but as Colonel Waring, the engineer of the new drainage works at Memphis, states, when reporting on the condition of Washington, "the particular idea of the size of a drainpipe required to receive the drainage of a house, or of a number of houses, is strangely in error. A pipe 6 inches in diameter, having an inclination of 4 inches in 100 feet, or less than half an inch in 10 feet, has a capacity of discharging nearly 200 gallons per minute, say 12,000 gallons per hour, or averaging between 3 and 11 in the morning 30,000 gallons. Such a pipe then," says he, "even at such a slight inclination would be adequate for the removal of 150,000 gallons per day. If each household averages six persons, and if the daily consumption is even 50 gallons per head, the service would suffice for 500 houses, or supposing the sewer to run half full, for 250 houses." These figures are attested by facts collected by Colonel Waring, concerning the passage of water through existing pipe-drains elsewhere, which had been carefully guaged. Mr. Chadwick confirms these statements, and states that his experience coincides therewith. It will thus be seen that certainly no single house needs a larger outfall pipe than 6 inches diameter. In some provincial towns it is limited to 4 inches, where proper flushing arrangements exist.

Nevertheless, ignoring all progress, in the last edition of a justly esteemed Encyclopædia, at page 701, under the head of "Specifications" the bewildered student may read as follows:—

"To execute proper barrel drains for draining the premises, as shown on the plans, to fall into a main sewer or cesspool as the case may be. The principal drains to be 18 inches, and the smaller ones 12-inch barrelled drains, with half brick rims, and the lower half of each drain composed with pure Parker's cement. . . . N. B.—We have here described the sizes of drains as for a moderate-sized mansion. We might say that 30 inches is the maximum diameter likely to be required for a large building, and none should be made less than 9 inches wide with half brick sides, three courses high, curved top and bottom."

I may add that Mr. Henry Robinson gives the following rule for calculating the flow in sewers:—

x = Area of sewer $\div$ the wetted perimeter in feet.
f = Fall in feet per mile.
v = Velocity in feet per minute. $v = 55\sqrt{x \times 2f}$
a = Area in square feet. $c = v \times a$
c = Cubic feet delivered per minute.

And now with regard to my second point: The remedies generally available for the reduction of the sanitary evils we condemn. In the first place I will draw your attention to the practice of specialists, whose system is more or less in harmony with the previous practice of those architects who have also given considerable attention to this subject. At the Annual Conference of the Society of Arts on the progress of public health, in June last, Mr. Rawlinson stated that house drainage was at the root of all sanitary reform, and he was pleased to inform us that Lord Spencer had kindly permitted the inspection of the system of drainage adopted at his Lordship's house at St. James's. Mr. Rawlinson added that, at that moment, as far as his knowledge extended, it was the most perfectly drained house in London or elsewhere. The principles upon which this mansion and many more, including Mr. Edwin Chadwick's at Mortlake, have confessedly been drained, will be found laid down by Mr. Rawlinson, of the Local Government Board, in his *Suggestions as to the preparation of district maps, and of plans for main sewerage, drainage and water supply.* The engineer employed was Mr. E. F. Griffith, one of three

gentlemen—engineers and specialists in sanitary matters—who have devoted themselves to sanitary engineering, and hold a representative position therein; and in the recently issued report of the Meeting of the Sanitary Section of the Society of Arts, in June last, the evidence of Messrs. Eassie, Rogers Field, and E. F. Griffith is given in full. Mr. Griffith thus summarizes the principles adopted by him:—

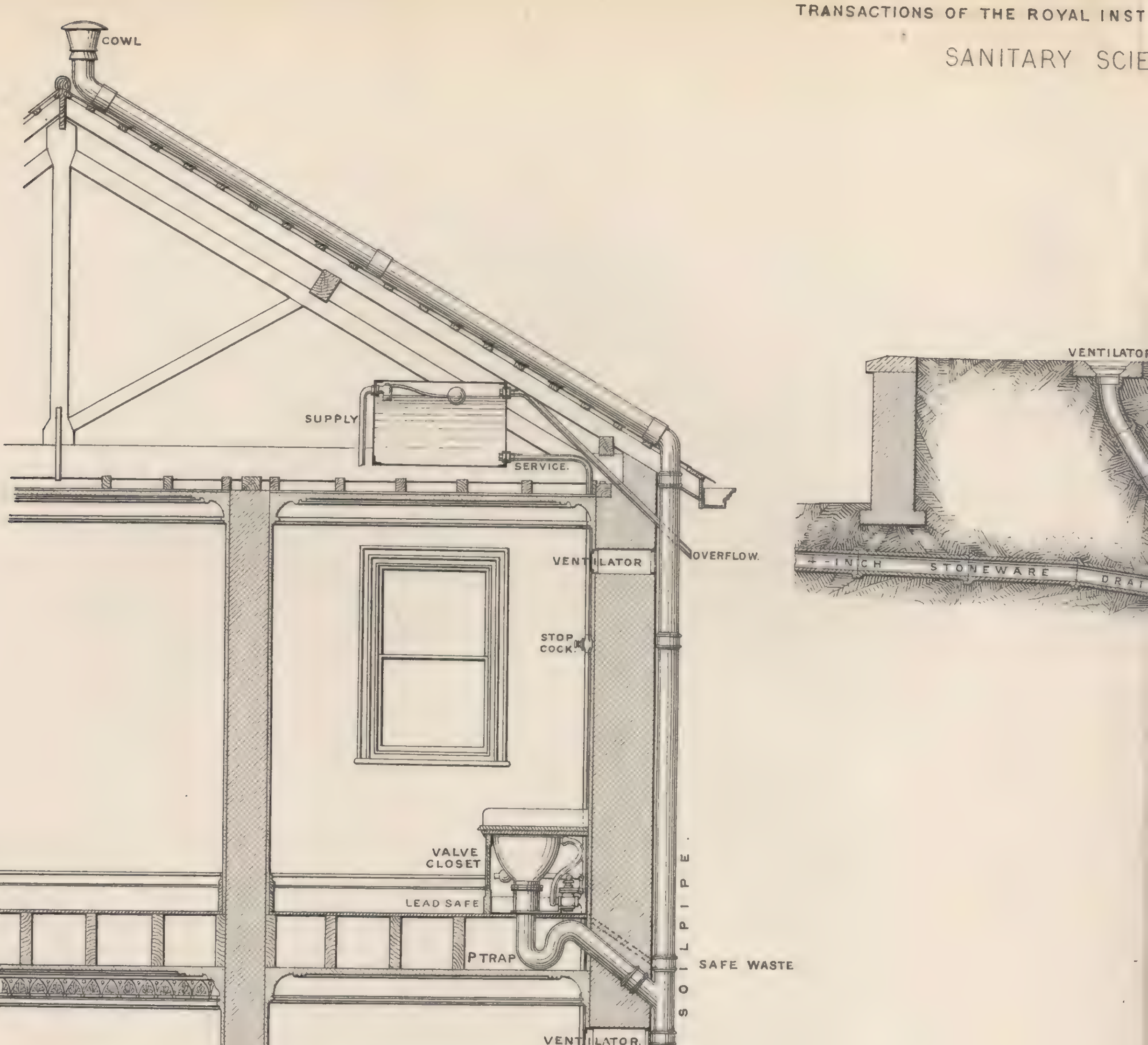
1. Communication between main sewer in street and housedrain should be disconnected or severed by an open air space being left between housedrain and sewer.
2. The housedrain should be laid to such a fall as to be self-cleansing, free from deposit, and ventilated; besides which it must be air and watertight.
3. The soilpipe should be fixed outside the house and taken up full-size above the roof.
4. The wastepipes from the safes of all closets should discharge into the open air instead of into the soilpipe or D-trap.
5. Then there should be no means of drawing water from the cistern or cisterns supplying closets, other than through the closets.
6. The wastepipes from sinks, baths, lavatories, &c., should be trapped underneath, and made to discharge immediately into the open air over trapped gullies.
7. There should be no connection or branch with the main housedrain, where laid underneath the house, except outside the main walls of the building.
8. "Pan-closets" with "D-traps" should never be used, nor should D-traps be fixed under sinks, &c.

Then follows the description of the manner of applying these principles, and in answer to the question, "After your examination of an ordinary London house, what course do you usually recommend?" Mr. Griffith said:—

"If I am instructed to place the house in a thoroughly sanitary condition, I first make a plan of the house showing exactly how the new drainage can be laid, and then proceed to have all the old drains and contaminated earth removed. Unless absolutely necessary I never lay a new drain underneath the house. Should it be necessary to lay a new drain under the house, I use an iron pipe, laid perfectly straight from a disconnecting manhole constructed in the front area to a manhole in the back area. Between these two manholes the iron pipe is laid perfectly air-tight and water-tight, and no branch drain or wastepipe is discharged into this iron drain between these two points; besides which it is laid to a good fall, which will ensure its being self-cleansing. This iron drain is completely severed from the main sewer in the street by the disconnecting manhole, which is constructed in the front area. All the branch drains discharge into a manhole, and every pipe is laid perfectly straight from point to point, a manhole or turning chamber being constructed where a change of direction takes place. Every drain and wastepipe is so laid that, in case of stoppage, it can be cleaned out without opening the ground, removing the paving, or cutting about the walls either inside or outside the house; besides which every drain and wastepipe is thoroughly ventilated. I fix the soilpipes from the closets *outside* the house, and take them up full-size above the roof. The closets would be fixed against outer walls only, and the soilpipes from them would discharge direct through the wall into the iron soilpipe fixed outside. In each closet some permanent ventilation would be made. The wastepipes from all sinks, baths, lavatories, &c., would discharge direct through the wall over the trapped gullies, or if above the ground level, into rainwater pipes, which would discharge over trapped gullies at the foot. The overflow from cisterns would discharge direct through the wall into the open air, so that in the case of the ball valve in the cistern being defective, the overflow water would immediately attract attention, and by this means prevent the waste of water which now often takes place, and, in many cases, continues for months without being remedied. The valve and wastepipes of the bath are made of such a size that whenever used, the housedrain will be flushed. The cistern or cisterns which supply the closets would be so made that no water could be drawn from them except through the closets, special reservoirs for the drinking water being supplied."

In answer to the question, "Why do you prefer cast-iron drains underneath the house?"

SANITARY SCIE



SYSTEM OF HOUSE DRAINAGE BY

E. F. Griffith, Delt.

ENCE IN ITS RELATION TO CIVIL ARCHITECTURE (Nº 5.)

Fig. III.

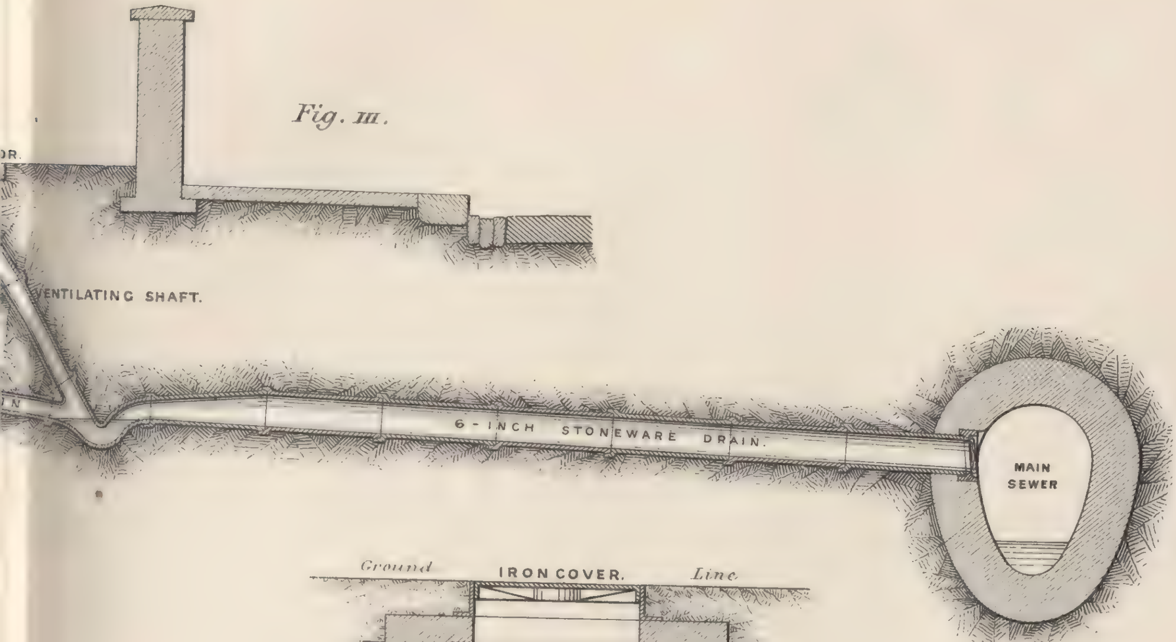
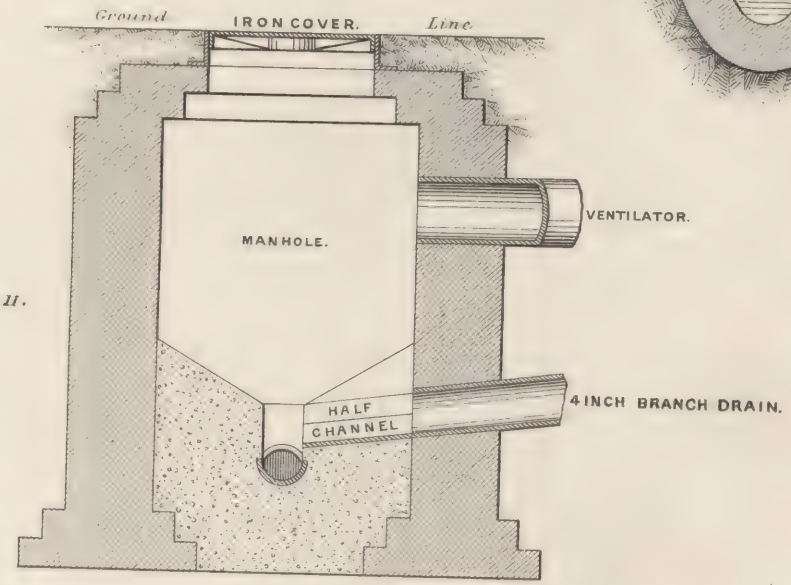
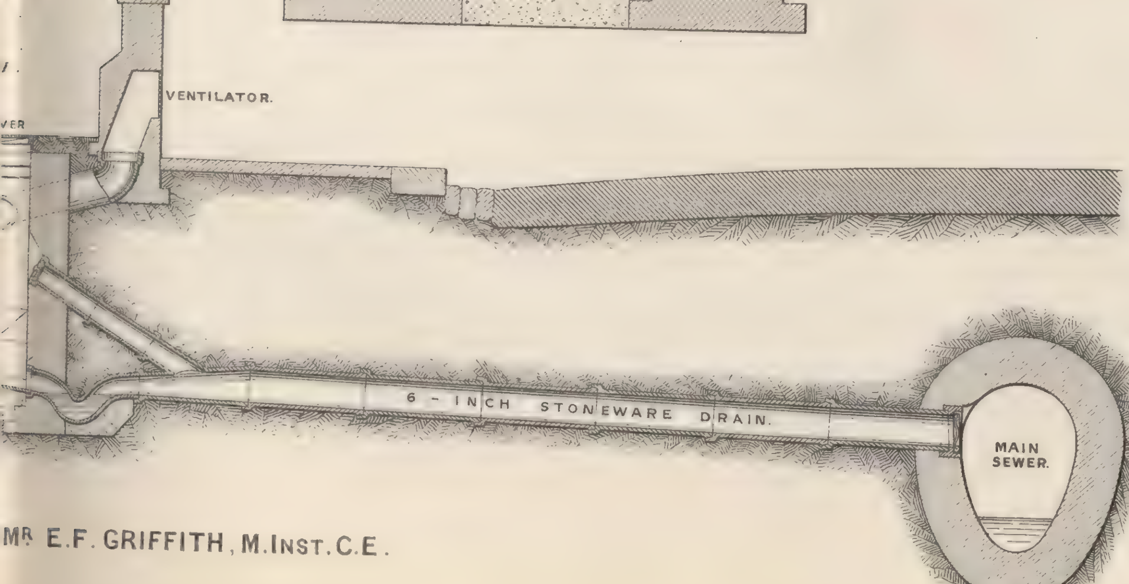


Fig. II.





MR E.F. GRIFFITH, M.INST.C.E.

C.F. Kell Lith. Castle St. Holborn, London E.C.

Mr. Griffith replied, "Stoneware pipes laid on a bed of good concrete can be used, but there is more chance of leakage through defective workmanship than with cast-iron drains, with lead and yarn joints." And as to the *fall* to be given to drains, he said: "All housedrains should be so laid that they are self-cleansing, not when running half full, as is usually calculated, but when they have only about an inch of sewage flowing in them. I never lay a 4-inch drain to a fall of less than 1 in 30, a 6-inch to a fall of less than 1 in 40, and a 9-inch to a fall of less than 1 in 60. When these falls cannot be obtained, then automatic flushing arrangements should be made. All houses, in my opinion," concludes Mr. Griffith, "should be so drained that when water is discharged into the housedrain from any bath or sink, closet, &c., the said water should be discharged in a body or volume so as to flush the drain."

The following is Mr. Griffith's description of the illustrations here given:—"It will of course be understood that these illustrations (Nos. 5 and 6) are purely typical and the conditions may vary greatly in each case which has to be dealt with. Fig. i illustrates a case in which the drains are all outside the house; a manhole or chamber is constructed on the line of drain both for the purpose of obtaining easy access to the drains in case of stoppage and for providing an 'air break' or 'disconnection;' a section (to a larger scale) of this manhole is given by Fig. ii. The syphon trap fixed in the side of the manhole next the sewer prevents, as a general rule, the passage of sewer gas into the house drain, but if by absorption or otherwise the gas does find its way into the manhole, it is there so much diluted that if it makes its escape through the ventilator to the manhole (as may be possible in certain states of the atmosphere) it is quite harmless. Generally speaking, however, there is a strong upward current of air in the housedrain caused by the soilpipe being carried full size above the roof, as shown, in which case the ventilating openings to the manhole serve as inlets for fresh air. Fig. iii shows another and cheaper mode of making the 'disconnection' of the housedrain from the sewer. In this case, a special syphon trap is fixed with a branch pipe carried to the surface as a ventilator. The principle is precisely the same as in fig. i, and is equally efficient in one respect, but if at any time it becomes necessary to examine the drain the ground or pavement has to be opened up. Water-closets should always be situated against two outer walls if possible and should have a small anteroom (which may be used as a lavatory) between them and the main part of the house. In a case where there are no windows near, it is sufficient to carry the soilpipe just above the eaves gutter. The closets themselves call for no special description, except that they should not have overflows, for two reasons, one being that defects in the water fittings are not so easily noticed, and the other, the danger of admitting foul air through the overflow pipe. Instead of the overflows, a lead safe should be fixed, and in all cases the waste from these should be taken direct through the wall. Illustration No. 6 gives the method adopted for disconnecting sink wastes. The section, fig. iv, shows a scullery sink on the ground floor and a housemaid's sink above; a plan of the scullery sink is shown at fig. vi, is fitted with a trap, and the waste (usually 2 inches in diameter) is carried to discharge over a stoneware gully fixed outside; the housemaid's sink, fig. v, if on the ground floor, is dealt with in exactly the same way, but if on an upper floor, as shown, the waste is carried into a rain-water head, the down-spout from which discharges with a shoe at the foot over a similar gully."

The evidence of Messrs. Eassie and Rogers Field coincided with that of Mr. Griffith in all material points, and to quote their opinion is the less necessary, inasmuch as Mr. Eassie has

published a book on *Healthy Houses,* of 250 pages, with 300 illustrations, which may be bought for a shilling; and Mr. Rogers Field's practice is well explained in his pamphlet published by Spon, entitled *Bye Laws and Regulations with reference to House Drainage adopted by the Uppingham Sanitary Authority, and allowed by the Local Government Board, with explanations and suggestions.* The following are the rules to be observed in the construction of all buildings erected under the Surveyors to the Office of Works and Public Buildings:—

1. All water-closets and urinals shall be constructed so that one wall at least of such closets and urinals shall be an outer wall of the building.
2. All soilpipes shall be carried outside the building and ventilated by means of pipes leading the foul gases above the highest point of the building, such pipes to be carried to points removed from chimney stacks.
3. Separate cisterns shall be constructed for the water-closets and for the general purposes of the building; no tap or "draw off" shall be affixed to any pipe communicating with a cistern supplying a water-closet or urinal.
4. All wastepipes and overflow pipes of cisterns shall terminate in the open air, and be cut off from all direct communication with drains.
5. Great attention shall be paid to insuring through ventilation in all rooms. Rooms so high that their ceilings shall be more than 2 feet above the top of the windows, corridors, staircases, and other open spaces, shall be specially ventilated so as to prevent the accumulation of stagnant air.
6. All main drains should, where practicable, be formed outside the building. In the event of its being necessary to carry a main drain underneath a building it must be trapped immediately outside the main wall, and a ventilating pipe must be carried from that point to the highest part of the roof, as under Rule 2."

These sanitary principles will be found variously applied by different architects, but not so generally as should be. A syphon trap is usually put on the sewer side of the manhole, and no manhole should be without ventilation, both an inlet and outlet clear of accesses to the interior of house. But the iron door of the manhole should only possess an open grating, when situated next a blank wall clear of all openings or children's approach, lest they should receive or inhale the impure air as it escapes by the grating.

Mr. G. Godwin's valuable papers on Hospital Construction, 20 years ago, were greatly influential in bringing about the present improved system of hospital planning. His profusely illustrated little books entitled *London Shadows, Town Swamps and Social Bridges, Another Blow for Life,* &c. have enlightened the public to the many trials of the poorer classes arising from their insanitary surroundings, and given an impetus to the work of various societies for improving the dwellings of the labouring classes. The late Mr. Henry Roberts's name must also be remembered with respect by all interested in this subject; his long connection with Lord Shaftesbury's Society, and the improvements made by him in cottage building and ventilation can never be forgotten. Mr. J. P. Seddon is the author of twelve Papers published in the *Architect* in 1873, under the title of "Sanitary Suggestions." He has also written Papers on "Sanitary Reports," "Cowls," "Water Supply Regulations," "Warming and Ventilation," &c., and his brother Major Seddon, a Royal Engineer, is too well known as an expert in sanitary matters to need further reference. Mr. Norman Shaw, R.A., has shown

SANITARY SCIENCE IN ITS RELATION TO CIVIL ARCHITECTURE. (Nº 6.)

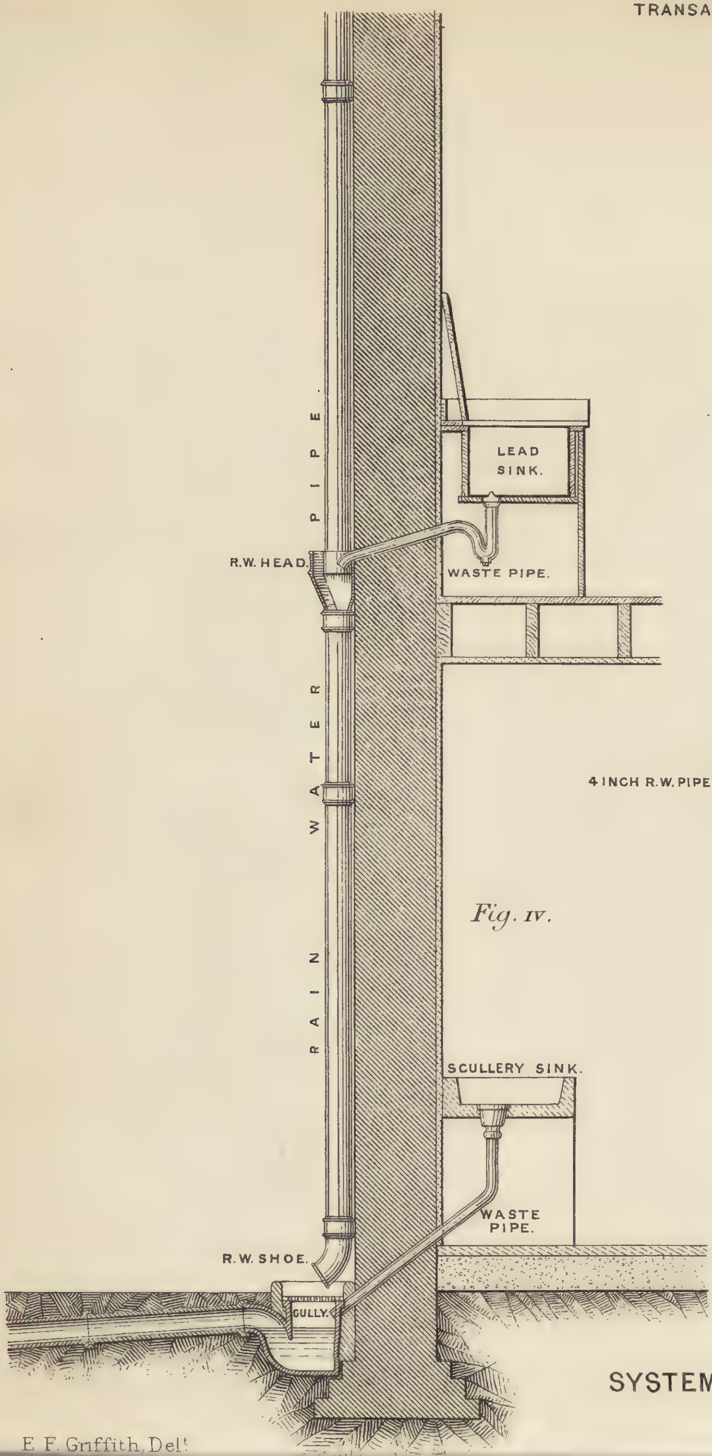


Fig. IV.

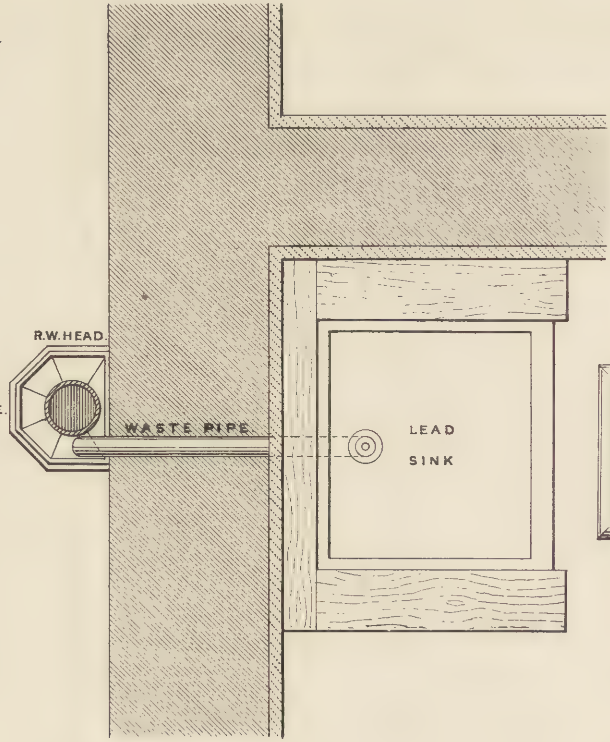


Fig. V.

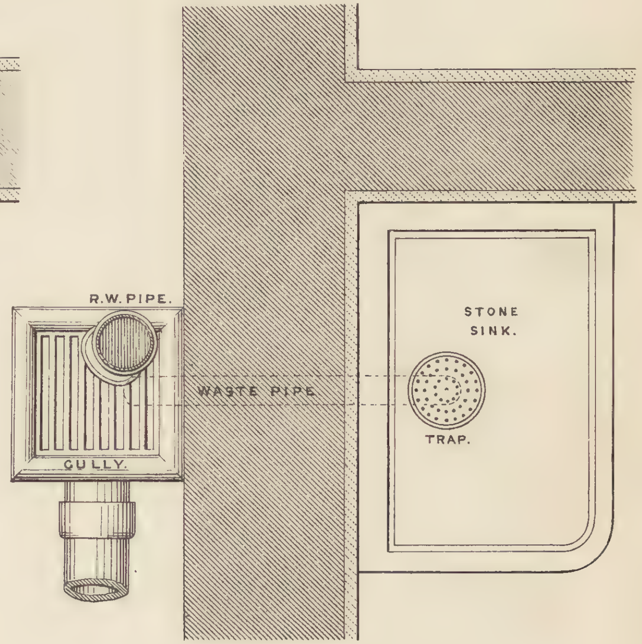


Fig. VI.

SYSTEM OF HOUSE DRAINAGE BY Mr. E.F GRIFFITH, M.Inst. C.E.

E. F. Griffith, Delt.

C F Kell, Lith Castle St. Holborn, London E.C.

by what simple means sewer gas may be absolutely disconnected from our dwellings; his process is well described in a pithy pamphlet he has published, wherein he speaks of "a little baby of his own, with which he is reasonably content after a trial of some five years." His plan is to use external stackpipes, open at both ends, for the passage of soil and other wastes, and he ignores and deprecates the intervention of all traps except one between his disconnecting open-mouthed drain, hopper and the pipe leading to the sewer. His answer to theoretical objectors is simply this: he does not find the evils suggested to occur in his own house nor in the many buildings to which he has applied his system, therefore he supposes it answers. At all events it has the great merit of singular simplicity and inexpensiveness, and the worst that can happen is but temporary inconvenience. Mr. William White, F.S.A., has written several Papers on the subject, and a valuable contribution in form of a pamphlet, entitled *Domestic Plumbing and Water Service.* Mr. Henry Saxon Snell has done good service by the conscientious manner in which he has worked out the sanitary contrivances which distinguish the various Metropolitan Workhouses erected under his superintendence. In the Parkes Museum may be seen his "Duplex lid" to water-closet fittings, an arrangement by which the purity of the air is secured within the apartment devoted to its use. He is also the inventor of an excellent hot water stove, heated by the open fire of the room, a singularly happy combination, also exhibited at the Parkes Museum.

I have mentioned these few names because something like a crusade has set in, not only by specialists, but by associated societies, such as that founded in 1878, at the suggestion of Professor Fleming Jenkin of Edinburgh, entitled "The Sanitary Protection Society." Professor Jenkin read a Paper at the Social Science Congress at Edinburgh, in which he stated that in consideration of an annual payment of one guinea the members obtained: 1st, a Report on the condition of his house; 2nd, Inspection of alterations made; 3rd, an annual experimental test of the condition of the drainage system. It was a mutual system then confined to Scotland, and there were already 500 members. The success of the Northern Society has led Professor Jenkin, who read a Paper at the Society of Arts on the subject, to establish a London Sanitary Protection Society, with Professor Huxley as president. There is yet another London Society called the "Sanitary Assurance Association," recently inaugurated at the Langham Hotel. The object of these societies is to bring the benefits of sound sanitary construction and design within the reach of the humblest householder.

With reference to the removal of excreta from buildings when no system of water carriage for sewage exists, I think it important to mention that the inodorous system of cesspool emptying by steam, adopted in France according to a patented process, invented by M. Talard, and introduced into this country by Mr. Laurie of Twickenham. I was one of a large company of gentlemen interested in sanitary matters who recently witnessed at Kew the process of emptying a large cesspool in this manner. The whole thing was done in a few minutes without the least effluvia being observable, though effected in the midst of a hot afternoon sun. As described by Mr. Laurie the process consists in pumping the excreta by the natural pressure of the atmosphere into a receiver from which all air has been first exhausted and a vacuum produced—in short, it is done with "pneumatic despatch." A steam vacuum pump is attached to a small portable locomotive engine to exhaust the air from the receiver, the pipes between this and the engine never being so much as soiled. The receivers

are made of light steel plates barrel shape, and of a capacity of about 3½ cube yards; they are mounted on framework, on four wheels, being easily moved from place to place by a pair of horses; each receiver is fitted with a glass indicator at one side to show how full it is, and has a large fullway valve at the lower end, to which the flexible tube is attached. On the cesspool being opened, a strong 5-inch flexible tube is plunged to the bottom of the contents, the other end of this tube being connected with the valve of the receiver; this has already been connected to the engine by a smaller tube from the upper part of the receiver. The engine being started the noxious gases are first extracted from the cesspool, passed through the furnace and burned; the air is then exhausted from the receiver, and on the valve being opened, the contents of the cesspool rush up through the galvanized iron connecting pipes, 6 inches in diameter, filling the vacuated receiver in about three or four minutes. The valve is then closed, the pipes disconnected, and the receiver taken away to be replaced by others, until the cesspool is entirely empty. It is obvious that at no time in the process is there any exposure of the excreta to the atmosphere. The receivers are either discharged into close barges for transit, or emptied into reservoirs, or run upon the land in the usual manner for fertilizing purposes. The secret of success, however, lies in the singularly simple yet perfectly air-tight system of joining pipe to pipe and to the receiver, occupying less than half a minute to adjust each joint; each length of pipe is capped at both ends when not in use, with a similar joint for securing same. In Paris the price paid for extraction is 5 francs per cubic metre or 3s. 6d. a cubic yard, or one third of the cost of our present mode of operating in this country, which averages half a guinea a yard.*

WARMING AND VENTILATION.—I have now arrived at the second general division of my subject, namely, "Ventilation," with which I must associate "Warming," owing to their close relationship. As Professor Jenkin once remarked to me, the study and control of the *pressure* of the atmosphere, and not the temperature only, is the key to all sound ventilation. As this pressure is increased or diminished in its utilization, so is ventilation promoted or retarded. The right government and direction of the currents of natural atmospheric pressure is the business

* A description of the method employed in some of the *maisons-à-loyer* recently erected near the Champs Elysées, for the separation of the liquid and the periodical removal of the solid matter was given in the *Builder*, in November, 1877, in an article entitled "Paris after ten years," of which the following is an extract:—"This block of houses possesses three *fosses* or cesspools; and we had the honour of entering one while operations for which a *fosse* is specially intended were proceeding. First, an ordinary wooden door was opened; we found ourselves in a narrow lobby, and it should be understood that this *fosse* was on the same level as the stables and cellars. Then an iron door was opened, and some pains had evidently been taken to render the door air-tight. There was no offensive odour; instead of a pool of liquid, we stepped upon a clean cement surface. A large opening near the top of the vault faced us; it was the ventilator. Next to it there was a large pipe descending into an iron cylinder of portable dimensions, raised a few feet from the floor. From the cylinder another pipe descended into the earth, and it was connected with the cylinder by a guttapercha tube. This machine, of a frightfully primitive nature, acts in the following manner: solid matter, descending by the common pipe which receives the discharge of each floor, remains in the cylinder, at the bottom of which is a narrow, well-protected grating; through that all the liquid oozes, by means of the guttapercha tube, into the drains, whereby it is conveyed by the street sewers to the Seine, at a distance from Paris. Every two days this chamber is visited by the servants of the company—undertakers, or rather contractors, for this system of drainage. The cylinder, disconnected from the pipe descending from above, and the guttapercha tube before mentioned, is carried off on the shoulders of two men; another empty cylinder is put in its place. Such a *fosse* is simply a clean empty cellar containing in one corner the rough machine which we have described."

of scientific ventilation, which pressure is always in the direction of the least resistance. There is what is called natural and artificial ventilation. The former acts by the force of diffusion by winds and by the difference in weight in masses of air of unequal temperature. Diffusion is an insufficient agent in ventilation, but it penetrates stone walls and permeates the soil and helps to produce damp basements only to be overcome by concrete laid over the whole site of the building.* But wind is a powerful ventilating agent, and finds its way everywhere. Märcker of Göttingen shows that it will penetrate through a loamy brick wall at the rate of 5-12 cubic metres per hour, when the difference in temperatures is 1° Centigrade. It is the unequal weight of atmospheres that gives rise to wind, and the pressure of dry cold air against moist warm air produces rapid interchange of cross currents and movements of the air largely available for ventilating purposes. The inequality of temperatures is a fruitful source of change in the air, and the direction of the forces produced by it is a necessary aim in ventilating processes. By a difference of temperatures of 70° inside and 40° outside (Fahrenheit), the air will force itself through a square yard of limestone wall at the rate of 10 cubic feet per hour. The preservation of the purity of the air about us is therefore as essential as that of the spring at its source.†

Dr. Parkes has shown in great detail the various sources of impurity to which the air of inclosed spaces is subject, and the particular diseases to which such impurities give rise. In our present inquiry, and as he suggests, it will be desirable to restrict the term ventilation to the removal, by a stream of pure air, of the pulmonary and cutaneous exhalations of men, and of the products of the combustion of lights in ordinary dwellings, to which must be added, in hospitals, the additional effluvia which proceed from the persons and discharges of the sick. All other causes of impurity of air ought to be excluded by cleanliness, proper removal of solid and fluid excreta, and attention to the conditions of surrounding dwellings. We have, therefore, firstly to consider what quantity of fresh air is required for the above purpose, and secondly the best method of supplying it. Assuming that we have succeeded in ventilating our drains and in excluding sewer gases from our buildings by the means and appliances already detailed in the first section of this Paper, our first inquiry must be, what is to be the measure of the impurities to be removed? Taking the presence of carbonic acid as the index of impurity, Dr. De Chaumont has shown by experiment that the organic impurity of the air is not perceptible to the senses until the carbonic acid rises to the ratio of ·6 per 1,000 volumes. At ·2 it is fresh, or not sensibly differing from the outer air; at ·4 it begins to be close; at ·6 it is decidedly close, the organic matter being disagreeable; at ·9 it is

* See Appendix C for note on subsoils, extracted from the author's lecture on "Situation," delivered at the Parkes Museum.

† TABLE showing pressure of wind per square foot at different velocities :—

3 miles an hour,	$\frac{3}{4}$ of an ounce	on each	square foot.	
$3\frac{1}{2}$	do.	1 ounce	do.	do.
5	do.	2 ounces	do.	do.
7 miles an hour,	4 ounces	on each	square foot.	
10	do.	8 do.	do.	do.
14	do.	1 lb.	do.	do.

TABLE showing passage of wind through walls. Märcker has given the following as the amount of air passing in one hour through a square metre of wall space, when the difference of temperature is 1° C. :—

	Cubic Metres of Air.
Sandstone	1·69
Limestone	2·32
Brick	2·83
Tufaceous Limestone	3·64
Loamy Brick	5·12

very close, the organic matter present being offensive and oppressive. The Doctor has also prepared *tables* which show the deterioration of the purity of the atmosphere produced by the respiration of one man in rooms varying from 100 to 1,000 cubical contents, and the amount of air necessary to dilute to the standard of ·2 for the first hour and for each succeeding hour, which are readily available in practice.* The amount of air required to do this has been fixed at 3,000 feet for each adult healthy person in an hour, and it follows that, the larger the air space, the less is the necessity for the frequent renewal of air, and the less the chance of draught. Thus a space of 100 cubic feet must have its air changed 30 times in the hour, if 3,000 cubic feet of air are to be given; while a space of 1,000 cubic feet need only have it changed three times in an hour for equal ventilation. Every foot of gas consumed is equivalent to the vitiation of the air produced by the respiration of one person. The difficulty of thus changing the air without draught is, however, very considerable, and Dr. Parkes observed that "*a change equal to four or three times per hour is generally all that can be borne under the conditions of warming in this country.*" In practice the change made rarely exceeds 750 cubic feet per head per hour. It is obvious, therefore, that warming the incoming air is a necessity in cold climates like our own; and consequently the principles of warming and ventilation are too intimately connected to be completely studied or applied alone. Changing the air of a room is not the less necessary because the cubical space included within its walls is large; the largest space can only provide sufficient air for a limited time. Even in a space of 10,000 cubic feet per head, the limit of admissible impurity would be reached in 3 or 4 hours; after which the same constant hourly supply of 2 or 3,000 feet would be as necessary as in a space of 100 cubic feet. Obviously it is not only important that the air should be changed, but that that change shall be for the better, by being drawn from a pure source, and carried through clean channels.

Ventilation means passage for the wind, change of air, or to use an expressive Americanism, atmospheric recuperation—both a way in for the air, and a way out for the same, which is the sole means of changing it, in any place or building, and no recuperative process can go on without it. Some people would seem to be possessed with a belief in infinite atmospheric compression; that it is only necessary to let air into a receptacle and that it will continue flowing on for ever. But to take an analogous element, the difference between air and water is only in degree; and as the full receptacle will hold no more water, so the vessel filled with air can take no more without unnatural compression. The temperature determines its bulk, and if equals be added to equals the remainders are equal. Airs of equal temperature are stagnant whether pure or impure; it is the ever varying temperature that chiefly constitutes the motive power and creates currents by varying pressures. As the difference in weight and temperature of the all embracing atmosphere in which we live and move and have our being gives motion to the winds, so wherever the winds are excluded from the interior of any place or building, an artificial difference in temperature becomes the needful provocative cause of movement through the inlets and outlets provided.

Natural ventilation is, then, the simple process of mingling the external with the internal atmosphere of a building. Scientific ventilation is one and the same thing, but with this difference, that in the former case it is free to mingle or not as it pleases, and in doing so to

* See Appendix E.

create many inconveniences; in the latter, direction is given to currents of air produced by its interchange, and a healthy commingling of the oxygen with the carbonic acid gas is secured without the dangerous and disagreeable accompaniment of draughts. In short, the business of ventilation is to direct the pressure of the currents of air admitted and required to overcome its stagnation, under conditions where no draught is admissible; and to do this by mechanical appliances for the introduction and withdrawal of the air directed by the scientific apposition and control of varying temperatures. With the thermometer for measuring the temperature of the air, the hydrometer for testing its humidity, and the barometer for determinating its weight, we have the means of estimating and testing by experiment the pressure of the atmosphere in any direction. The measurement of the force of the currents of air produced by the difference of temperature, &c., existing between the external and internal air of a building is accomplished by the use of the anemometer or manometer. The natural process by which the temperature of the air is raised is twofold—by radiation and by conduction. Radiated heat has the peculiarity of passing directly through any intervening space or air without parting sensibly with its heat, and warming the first obstacle to its passage, such as a wall or window, with which it comes in contact. Conducted heat, on the other hand, is the warmth given off by any surface by direct contact with any substance, whether air or otherwise. The sun shining from its distance cannot part with any conducted heat, excepting the minute quantity given off by its rays to the dust in the air when passing through the same. It therefore heats practically by radiation alone, the warmth passing into the earth, and from that being given off gradually to the surrounding atmosphere—hence the difference of temperature in the sun and in the shade. In the case of open fires nearly the same result is attained, though at great outlay in fuel. The conducted heat of the fire passes into the air escaping up the chimney, and is lost for heating purposes, while the radiated heat alone is available for raising the temperature of the room; this warmth first passes into the outer surfaces, and is then given off by them by conduction into the atmosphere. Radiated cold from the outer surfaces, which is the chief source of the feeling of cold, is thus avoided, and a pleasant and agreeable result is quickly attained. Artificial heating, on the other hand, inverts the above principle by employing hot surfaces placed in immediate contact with the atmosphere. These, though giving off a certain proportion of their heat by radiation (which proportion increases with their temperature), yield the greater quantity by conduction to the surrounding air, which in turn gradually warms the inclosing walls, &c., instead of, as before, first warming the walls and then the air. The moisture contained in the air, or which should be contained by it, varies directly with its temperature, and when the atmosphere is violently raised in heat without provision for the proper additional proportion, it will seize on any moisture within its reach, causing a dryness of the skin, drawing the woodwork in the building, and producing other disagreeable effects. This is another reason why an Englishman's instinct leads him, while ignorant of the cause, to hold to his open fire. Draught is, however, an inconvenience inseparable from the use of open fires in unventilated rooms, especially where they are placed opposite the doors, since they draw large quantities of air across the floor, and pass it up the chimney: to reduce the evil they should be placed side by side, and if this were carried into effect far less would be heard of cold feet. Cleanliness is a virtue for which the open fire is not usually praised, whereas, as a matter of fact, it is far cleaner in its use than any means of heating by conduction. The latter, circulating the air and always in

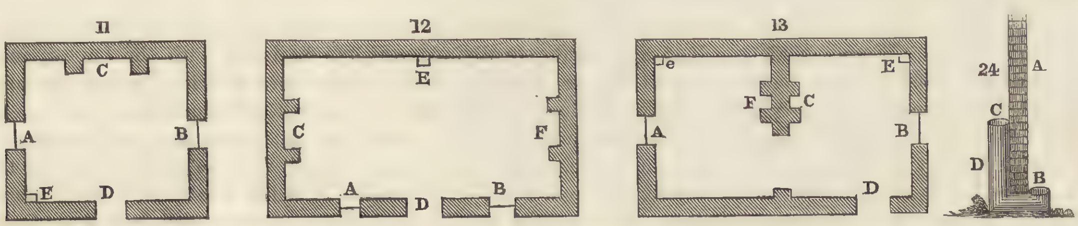
the same lines, causes the dust particles to settle over the whole surface of the walls and ceiling, and gradually to discolour everything, whereas in the case of the open fire, where the upper stratum of the air is uniform in its motion, this is not the case. This phenomenon may be noticed at any vertical opening for emitting hot air. Thus at the New Station in Magdeburg there are, in the walls of the Refreshment-room, four such openings about eight feet from the ground, and each one is ornamented from thence to the ceiling, some 15 feet, with a broad black streak produced solely in this way, the sooty particles in the air being drawn towards the stream of air rarefied by heat and settling on the walls. With justice, therefore, an Englishman may love his open fire, the comforts of which cannot be denied, or its advantages disparaged; but it is practically impossible to adopt it in all cases. It is not inexpensive either in first cost, when all its adjuncts, in the shape of chimney breasts, mantel pieces, stoves and hearths are taken into account; when adopted, as a rule, it is only used for heating a few particular rooms (the rest being left cold) and it heats these at a great outlay of fuel. A German, Russian or Belgian with his little fire in a colossal stove obtains five times the effect in half the time, more especially because he builds his house with some reference to the heat he loses by his outer surfaces. All the best authorities agree that no system of warming or ventilation is better for the absence of the open fire stove; it is not only the best heater by radiation, but it is the best ventilator by extraction as opposed to propulsion. Ventilation by extraction is produced by the application of heat either at the bottom or the top of a ventilating shaft so as to cause an upward current therein by the action of a fire, steam jet, hot water, or by a fan or screw used for the purpose of drawing out air. The constant current up a chimney when the fire is burning is in proportion, of course, to the size of the fire and the flue therefrom, but the usual current of a sitting-room fire of ordinary dimensions, as tested by the anemometer, is from three to six feet per second. If the area of the section where the anemometer is placed is known, the discharge can be stated in cubic feet; and even when there is no fire, the velocity of the upward current in the flue is usually from 1½ to 3 feet per second. With an ordinary fire a chimney gives a sufficient discharge for four or five persons, above that number special appliances are required. The strength of the draught in the fire often causes down draughts in flues intended to act as outlets, unless there are inlets of equal area or greater to the outlets and to the smoke flue of the chimney. The ventilation of mines is carried on upon the same principle as this—that is, by lighting a fire at the base of the upcast shaft, by which the air is drawn down the intake shaft, and permeates all the workings of the mine in its endeavour to reach the vacuum formed by the rarefaction of the air in the heated upcast shaft. The skilfulness with which the air is directed may be judged of by the fact that in some mines a portion of the air makes a circuit of from 30 to 40 miles before it can arrive at the upcast shaft.

Much difference of opinion exists both as to the size and the position of inlets and outlets. With regard to size, it is desirable to make each individual inlet opening not larger than from 60 to 80 superficial inches in area, or enough for three or four men, and to make the outlets about a foot square, or enough for six men. Distribution is more certain with several small openings variously placed, but the total area of inlets and outlets may be equal. The position of inlets should be opposite outlets, and on the same side of the room as the fire if there is one, or if the room is heated by a coil of pipes the incoming air should pass through the coil; if no means of heating the incoming air is available, the inlet should be in the upper part of the room and be directed

towards the ceiling, or through shafts from the floor level known as "Tobin's." Cold air should either be heated on its entrance, or the inlets brought so near to the fire that it may draw from them without creating draught or checking the flow in the upcast extract shafts in the opposite wall. But both inlets and outlets may be at the bottom of the room, provided the fresh air is passed through the warming apparatus and the vitiated air is drawn through descending flues to the foot of a lofty shaft heated by a furnace; the lower the level at which the extract shaft enters the furnace the greater the extracting power, provided always the horizontal flue is not too long. The "Hygiastic" stoves bring in fresh air after passing it under the hearth and heated back and sides of the stove; the size of the gratings is determined by the cubical contents of the room to be warmed and ventilated, and it is under control by an endless screw handle for opening and closing the louvres provided. I know no better exposition of the principles which should govern the design of such stoves than that given in Captain Galton's last book, illustrated by stoves of his own design, which have long been in use in military buildings. The introduction of air by vertical shafts suggested, nearly a hundred years ago, by a Mr. Whitehurst, is a sound principle eminently suited to the requirements of ordinary-sized rooms heated by the open fire grate only. A minimum of draught is achieved by it over any other system of direct introduction of cold air. So much has been written and said upon this so-called modern invention that I venture to print here some extracts from the pamphlet containing Mr. Whitehurst's ingenious suggestions, together with its title and preface:—

"OBSERVATIONS ON THE VENTILATION OF ROOMS; ON THE CONSTRUCTION OF CHIMNEYS; AND ON GARDEN STOVES. Principally collected from Papers left by the late JOHN WHITEHURST, F.R.S. London: Printed for W. Bent, Paternoster-Row, 1794. ADVERTISEMENT.—About ten years ago the late Mr. John Whitehurst, who died in 1788, had nearly completed for the press, a Treatise on Ventilation, on Chimneys, and the Construction of Garden Stoves, which was accidentally destroyed, and never afterwards replaced. The papers on which that treatise had been founded, were referred to me [R. Willan] for examination some time after his death. They consisted chiefly of remarks and memorandums relative to the subject, put down without order or connection. On a careful perusal of them, thinking the observations judicious, and not unworthy of public attention, I endeavoured to arrange them and to supply several deficiencies. This I was the better enabled to do, from having had frequent opportunities, during a long intimacy with Mr. Whitehurst, of learning his sentiments on the most material points . . . The latest publication on the same subject is by the celebrated Dr. Franklin. His letter to Dr. Ingenhousz on the construction and use of chimneys affords many useful hints, but does not, I think, supersede the more enlarged plan of Mr. Whitehurst. Without derogating from the merit of Dr. Franklin's Essay, I may be allowed to observe, that we are in some respects indebted for it to Mr. Whitehurst, the Doctor having been first induced by him to attend to the subject of ventilation and chimneys, while on a visit at Mr. Whitehurst's house in Derby during the summer of the year 1774. . . . .

"CHAP. II. . . . . Let fig. 11 represent the plan of a cottage, having one chimney C, one door D, and two windows A, B. Suppose first the door and windows to be air-tight, or so closely



fitted, that they do not admit a quantity of external air sufficient to carry up the smoke in the chimney. The house will in that case be incommoded with smoke and stagnant air. If then a window or door be opened, the chimney obtains a supply of fresh air, and performs its office in carrying off the smoke properly. This circumstance points out to us a remedy for the defect, by making some convenient aperture into the house,

which, however, must be done with caution, for if the opening is either at the door or window, the stream of cold air flowing from thence, will not only be unpleasant, particularly in winter, but very injurious to the inhabitants. What I should propose for the purpose, is an air-duct, three or four feet long, to be fixed in either corner of the room most remote from the fire, as at E, and communicating with the external air through the wall. The diameter of the duct must be from five to six inches. The air admitted by this means will ascend in a perpendicular direction to the ceiling; and being gradually diffused will soon acquire the temperature of the room. While this process goes on, no person within is sensible of it, nor is the flame of a candle in the least disturbed by it. At the same time smoke and stagnant air are effectually removed. If the air should be admitted near the fire, the chimney will act equally well, but the circulation through the room cannot be so perfect, for as the fresh air must take the nearest course to the chimney it would leave that which is contained in other parts of the room nearly quiescent, whereby it would become less fit for respiration.

"Let us next consider the consequences arising from two chimneys in one and the same room, as at C F, fig. 12, other circumstances remaining as before.

1. If a fire be placed at C that chimney will not smoke, although the door and windows be perfectly close, because a supply of air must come from the other chimney.
2. If it were requisite to have a fire at F also, the smoke in that chimney could not ascend at all, on account of the current of air passing down it to supply C, or reversely if the fire were placed first at F, the chimney C would then smoke for the same reason.

"To remove the defect in this case without injuring the inhabitants, and to enable both chimneys to act well at the same time, it becomes necessary to apply an air-duct as in the foregoing instance, but in a different situation. Its capacity must also be enlarged, since two chimneys are to be supplied with air instead of one. A duct whose side is seven inches may answer the purpose, its area will then be forty-nine inches, or nearly double to that of the former, whose side was estimated only at five inches. The most proper situation for it is at an equal distance from each fire, as at E, because a stream of air flowing up from thence will have the greatest possible effect in ventilating the room. An air-duct at any of the corners might indeed afford a supply to the chimneys, sufficient to prevent them from smoking, but could only change the internal air partially. Let fig. 13 represent the plan of a cottage, consisting of two rooms with the door D, and windows A B, close. A fire in the chimney C would not smoke since it must have a constant supply of air from the chimney F. But if the wind should happen to blow in the direction from C to F, the smoke rising from C would be carried down again with the air in F, and fill both the rooms. One air-duct might here also prevent the chimneys from smoking; but with a view to ventilation I should recommend two, situated as at E and e, which would always keep up a proper circulation of air through both the rooms.* . . . .

"Having provided for a general supply of air to the house, we should in the next place regulate the mode of its admission into each room separately, both above and below stairs, so as not to injure the architecture or to occasion any deformity, which may be done easily and without expense in the first construction of a building. I have employed in several instances the following method with advantage: I leave an open space between the upper part of the architrave, surrounding the door and the wall, on each side of the door, and likewise an open space between the casing and the lintel.

"The air then descends between the architrave and the wall on the outside of the door, and ascends between the architrave and the wall on the inside of the room. The current thus admitted rises in a perpendicular direction toward the ceiling, and acquires the temperature of the room, circulating through it imperceptibly to the inhabitants. At the same time it prevents any accumulation of stagnant air, and removes the smoke of candles, which is otherwise very pernicious.

"A similar mode of ventilation may be applied to all the rooms, however great their number, with the same beneficial effects. It renders the smallest apartments equally pleasant and healthful with the largest, and prevents the smoke from descending when the door shuts. In small rooms more especially, when they are furnished with an air-duct, it is proper to have the doors and windows as closely fitted as possible.

"Although the salutary tendency of this plan must be obvious when fully considered, there still remains a prejudice against it in the minds of the multitude. They obstinately maintain that the same injuries are to be expected from air admitted in this manner, as from the cold streams of it which usually flow into a room through the crevices of the door or window. However, the plan I propose is not recommended from theoretical

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* The form of the suggested air-duct is shown in fig. 24 (see woodcut). A, represents an external wall; B, C, is the air-duct. Mr. Whitehurst further suggests that "the part C, D, should be a box of wood, the rest brick;" and "if necessary an iron grate may be laid over the aperture B."

speculation; it has sufficiently stood the test of experience, and to that alone we can properly appeal. Beside its own peculiar advantages, it effectually prevents those disagreeable sensations, occasioned by lateral currents of air, which chill the body on one side, while it is heated on the other, nor can its operation at all produce the same dangerous consequences, since the air introduced by it, being gradually and insensibly diffused, distributes an uniform heat round the room.

"I do not propose the method of ventilation above stated as the best in all possible cases. There is so great a diversity in buildings that a variety of modes may be adapted to produce the same effect. The application of the principles must then be regulated by circumstances, and by the discretion of the architect.

"A few general hints will, however, serve to facilitate the process. If the kitchen be connected with the house by a passage, or by any other means, it becomes necessary to apply an air-duct of considerable size for the use of that room alone. The area of the tube should not be less than one hundred and forty-four inches in a moderate kitchen; for if the chimney there have not a full supply independently it will draw air from some or all of the chimneys in the house.

"Different modes may be adapted to answer this purpose:—

1. A perforation of twelve inches square may be made in the kitchen wall near the bottom, to which a tube must be fitted as usual.
2. If circumstances do not allow of such an opening, air may be admitted by raising the sash five or six inches above the sill, and applying a board at about the same distance from the window to direct the stream of air towards the ceiling. This board should be one foot broad or somewhat more, and may be suspended on hinges so as to let down in the night if the window shutters require to be then closed. In lofty kitchens, where there are small sashes, one of the windows is often hung upon an axis horizontally, so as to open or shut at pleasure by a line fixed to it. The inclination of the open windows affords a supply of air to the chimney, and defends the floor from rain; but it does not prevent the inconvenience from the wind blowing downwards into the room.

"In some rooms where it is not convenient to make a perforation, air may be admitted between the folding of the sash-frames by cutting away about the eighth of an inch from the frame, leaving the whole substance at each style. This is only practicable when there are shutters on the outside, and not on the inside of the window. For by inside shutters the current of air upwards is obstructed, whence it rushes through the crevices in various directions, and produces unpleasant effects."

Mr. D. O. Boyd has spent his life in trying to aid us in our endeavours to satisfy our clients and to please ourselves in laudable efforts to warm and ventilate at one and the same time. His latest stove combines many advantages and is adopted at Lincoln's Inn by Mr. Waterhouse. The incoming air is received into a sub-basement purifying chamber after it has been cleansed of all impurities by passing through a moistened filtering apparatus. The air so purified is conducted by flues to a chamber underneath the iron hearth of the new stove, which stands clear of the walls and allows the fresh air, after taking a tortuous passage through the warm air chambers of the stove to rise out of and over the centre of the stove into the room, on the same principle as that of Mr. Whitehurst, but pure, sweet and warm, and in large quantities. The air flue ceases at the stove hearth, but is continued again above the same in the form of a smoke flue from the upper part of the stove. No other ventilation than this incoming air withdrawn, after its revolution through the room, by the open fire grate, is necessary, when there are not more than four or five persons, but in class rooms and where numbers congregate supplementary inlets and extract shafts would be required if the exchange of from 750 to 3,000 feet per head per hour is to be maintained. It is more than 20 years ago since I used Mr. Boyd's cast iron flue plates to divide smoke flues, the merit of which was that the 4½ withe was left hollow between the smoke flues, and provided at a minimum of cost and space, a warmed air extract shaft for ventilating the apartment without entering the smoke flue. I used them with success in 1861, when I erected Mr. Horniman's house on the Warren Hill at Croydon. Then there is Mr. Henry Saxon Snell's "Thermhydric

Ventilating Hot Water Open Fire Grate." This invention consists of an open fire grate surrounded on three sides and on the top by a wrought iron chamber containing water, which when warmed by the fire circulates through upright coils of pipes placed on either side. The hearth is made of iron, and the whole space below the grate and pipes is formed into a chamber for the admission, collection and warming of air from the outside. The air cannot be burnt or be heated above the temperature of boiling water, and the water contained in the vase, being slightly warmed, evaporates and thus keeps the air of the room moist. I have drawn attention to this stove because it was approved and used at the Norfolk and Norwich Infirmary and elsewhere by the late Mr. Thomas Henry Wyatt, whose practice in hospital building was extensive and carefully studied from a sanitary point of view. This leads me to refer to his latest work carried out in association with his son, who now acts as architect to the New Hospital for Consumption at Brompton; my attention to which hospital was called by my friend Dr. R. E. Thompson in a letter describing the heating and ventilating processes, in which he has greatly interested himself.

Dr. Thompson thus summarizes his own views:—"I think that air should be admitted at the level of the various floors, and not from an underground chamber; also that the air so admitted should come from the east and west sides if practicable, and should in any case be passed over tubes of hot water. Air of uniform temperature is disagreeable and oppressive, it is better that the upper air should be colder than that of the floor, and that the warm air as it rises from the floor level should be cooled and agitated as it mixes with the upper air by the incoming cooler air. The foul air should be extracted by the open fire and by the extracting flues at the top of the room, which should be heated by gas jets below, or made to communicate with a hot air chamber above and in connection with turrets forming ventilating towers." With regard to water-closets he considers that the room they occupy should be heated to a higher temperature than the passages leading to them, and a separate means of extraction should be adopted—and he is right. These principles have been attempted to be carried out at the New Hospital. Mr. Haden has been intrusted with the heating and ventilating arrangements under contract to change the air some 4000 feet per head per hour. He has provided low pressure coils to stand in the recess formed by the back of nearly every window in the building, through which the external air is to come by the gratings provided under every window. The rooms will be rather over than under ventilated. Open fires are in every ward, and extract shafts as required, communicating with the hot air chamber which surrounds the attic at the base of the mansarde roof, and is connected with the four ventilating towers. The hot air chamber is heated by the steam pipes from the engine boilers in the basement. The boilers for heating the hot water piping are very large, but when cost and space is not a difficulty, the low pressure system is most manageable and least deleterious in its action upon the air which is warmed by contact with its surface.

I agree with Dr. Thompson that there are some disadvantages in the system which has been adopted in many important buildings with varying success, namely, that of underground reservoirs for the accumulation of heated air to be transmitted through shafts to the different rooms in a building, the fresh air being admitted to this heated chamber through the floor of it. I have adopted it myself at the Choir Schools attached to St. Andrew's Church, Wells Street, using low pressure piping—with the effect on the walls noticed

at Magdeburg. It has been employed at the Jonson Street Board Schools at Stepney, and many other buildings, but notably that of Sir Joshua Mason's Science College at Birmingham. A chamber about 7 feet high and 9 feet wide and above 100 feet long is filled from end to end with low pressure hot water pipes, and the brick arch forming the floor is also the roof of another chamber for the reception of the fresh air from without, which is admitted through the same by the openings left for that purpose. The flues conducting the air to the several rooms lead from this chamber, and the current of air is very strong, carrying the warmed fresh air which is admitted at pleasure by gratings provided with a means of limiting the supply to suit the needs of the moment. Everything depends on the cleanliness of these vast chambers, and there have been cases in which, from the carelessness of the attendants, decayed organic and vegetable matter has been allowed to accumulate in or near the chambers, and in one case within my knowledge, a defective soil drain delivered its contents therein. It is obvious that the whole institution is rendered unwholesome if anything go wrong with this great lung of the building, whereas by separately heating each apartment, any defects are confined to the space where the damage may have occurred. It has been found in practice that cumbersome systems of ventilation are less manageable and more costly than simpler means, and in not a few cases, both here and in Paris, the original comprehensive plan of artificial ventilation has been superseded for less ambitious but more effective means. There are circumstances wherein a system of heating and ventilating by propulsion is alone applicable, and wherever a strong draught is required to draw off the vitiated air of any building, or where great distances have to be traversed, no more effective means can be resorted to, especially where a steam or gas engine is available for the motive power required to turn the fans.

There are many systems of heating by hot air, by steam, and by gas, but my experience

* In the new Technical Schools at Finsbury is an example of heating and ventilating by propulsion. The heating surfaces are placed in a common central chamber, with fresh air driven over them by two powerful fans and distributed by means of horizontal channels through the whole building, connected by means of rising shafts to each floor and room, and delivering into the upper part of the same. High pressure wrought iron small bore piping is to be used, of which the heating chamber contains some 3500 superficial feet. The boilers are adjacent—and so is the three-horse power engine required for driving the fans, which are 7 feet in diameter with blades 3 feet 6 inches across; 100 revolutions a minute are made, delivering the air at the rate of 15 feet per second, but it is made to enter the rooms at the rate of 3 or 4 feet and not exceeding 6 or 8 feet per second. Taking the air from the outside at a mean winter temperature of 39°, 1640,000 cubic feet of air can be driven through the building per hour—each fan blowing one half of the above quantity. The air is driven into the hot chamber, entering at the bottom, and is compelled by a plate iron division to pass up and down through the heating surface before reaching the main distributing channel, which passes under the flooring right and left, graduated in area according to the number and size of the upcast shafts they have to serve. The iron gratings through which the warm air is forced into the rooms are sufficiently large to permit of a current of 3 or 4 feet per second, and are fitted with valves to regulate the supply. The fresh warmed air is admitted, either above or below the ordinary level of the pupils' heads, by a double set of ventilators. For the exit of the foul air, shafts are left in the walls running through to the roof, having extract openings into the same near the floor or ceiling and as far as possible from the fresh air inlets, and thus provision is made for both summer and winter ventilation. The central chimney shaft from the furnace in basement rises to the height of 120 feet, and is used for drawing off the foul gases and vapours from the great laboratory and experimental closets in the various chemical departments. There are above a dozen large stink closets to be evacuated once every minute, from which collectively 52,320 cubic feet of air are drawn off per hour. And there are forty-seven draught tubes from the various operation benches, which withdraw 141,000 cubic feet per hour. The draught chimney extracts 196,420 cubic feet per hour in

is not greatly in favour of them; when I get beyond the power of open fire stoves, I generally resort to hot water as a means of conducting and concentrating heat wherever I most require it. Twice I have had to substitute hot water for hot air systems in churches.

There are two leading principles governing the supply of hot water piping for heating purposes, termed high pressure and low pressure; that is to say, the latter provides for the supply of water in more or less large pipes at a low temperature, which cannot exceed boiling point, and the former circulates the water at a high temperature, but usually under 300°, in very strong wrought iron pipes of very small bore, rarely exceeding 1 inch in diameter. A particular description of this high pressure system will be given in the appendix and contrasted with other systems, because I do not think its convenience and inexpensive effectiveness are so well known as they should be. I have had equally good results from the use of the low pressure system, and have by no means omitted to avail myself of its advantages in a variety of cases where the means were forthcoming for its first cost, and it is too well known and too often applied to need any particular mention. The only danger to be apprehended from the use of water for heating purposes is the risk of its freezing in frosty weather when only intermittently used, but this evil is quite overcome by the non-freezing liquid now used for the purpose, at least in the high pressure system, which latter, as now practised and associated with proper ventilation, is as free from danger as any other. In the appendices to this Paper will be found a comparative description of the various systems of heating, and the various formulas in use by which their relative effectiveness is arrived at, prepared for me by Mr. A. J. Bacon.* I am now simply urging the greater consideration of the subject generally as it applies to ventilation, because of its bearing upon the health of the community through the healthful construction or otherwise of buildings generally; and I have, with the generous assistance of Mr. Bacon, worked out in detail the heating and ventilation of a single class room.† The application of the foregoing principles to dwelling-houses generally is given in an extract‡ from my lecture on "Ventilation, Lighting and Warming" delivered at the Parkes Museum. But I have said enough to show that the practice of Civil Architecture cannot be divorced from Sanitary Science, for obviously it underlies all our work and is as important an element in it as any one of the constructive sciences with which we are bound to be familiar.

PROFESSOR CORFIELD, M.A., M.D. (Oxon).—I could have wished that the President had called upon some one more experienced and older than myself to open this Discussion, but when I was asked to do so it was put before me in this way: it was considered that some one not a Member of the Institute should open the Discussion; and as I had been a

summer, and 269,845 cubic feet in winter. And this is achieved by causing the extract flues to descend to the base of the shaft, which being 120 feet high carries the air up with a great draught. The quantity of fresh air admitted to the laboratory only in summer is 160,200 cubic feet, and in the winter 217,525 cubic feet per hour. The velocity in the branch flues is 5 feet per second, the descending flue 5 feet 6 inches, and the upcast shaft 6 feet per second. In summer the fans drive in cold fresh air by the shafts, the pipes of the heating chamber not being at work as in the winter; and it can be admitted at the top or the bottom of the rooms at pleasure. The extract shafts which in winter are at the bottom, in summer are at the top or near the ceiling. In all seasons the fume closets and suction shafts of operating tables in the laboratory and elsewhere are evacuated by the descending shaft to which the fumes are led by the floor channels to the base of the chimney shaft.

* See Appendix A. † See Appendix B. ‡ See Appendix D.

good many years practically connected with the carrying out of sanitary work, and with sanitary science generally, I felt I could not refuse. Another matter that removed further hesitation was my anxiety to take advantage of the opportunity to state in this place the great debt of gratitude that I owe to many members of the architectural profession for the cordiality and courtesy with which they have met me in business matters. A great deal has been said lately, as you know, about architects. They have been told that they do not know their business, that they are ignorant of drainage, and that all the faults connected with houses (and goodness knows there are plenty of them) are to be laid at the door of architects; but I can safely say that I have never met any architect whom I did not find solicitous for the welfare of those who employed him. Mr. Robins has said at the end of his valuable Paper that civil architecture can never be divorced from the experience of sanitary science. I would go rather further even than that, and would say that if it were not for the experiments made by scientific men no alteration in principle would be carried out, not only in architecture but in almost anything else. If it had not been for the chemist Pasteur, for instance, all the vine-growers in the world would never have discovered the cause of the destruction of their vines; the fowl-keepers would never have discovered the reason for the loss of hundreds of thousands of their poultry; the prevention of the silkworm disease would have remained an unknown problem; and so it is in these matters. For a very long time we have been going on in a way with regard to the drainage of our houses, which has not been sufficient, which has been what is called "the bottling-up of the foul air system." That has been found not to be sufficient by practical experiment, but even after this we might have been content to go on for the next hundred years constructing sewers continually full of foul air if it had not been for some remarkable series of experiments that have been conducted by scientific men. What is it that has of late years caused anxiety? What is it that has caused us to think so much of sewer air? There is one reason and only one, and that is, that it has been shown by scientific experiment—by the experiments of sanitary science—that enteric or typhoid fever is produced by a constituent of that air. Since then it has been shown that other diseases are produced by that air. It is quite true that before this we knew in a general indefinite way that a bad state of health was caused by breathing bad air, but until it was found that there was a fatal disease called enteric fever—the existence of which we were not even aware of forty years ago—communicated largely by means of foul air, the public mind was not aroused to the necessity for its prevention. Nor was it aroused until one or two members of the Royal Family suffered from that disease. Another important series of experiments demonstrated the fact that the poison of this disease is not a gas, that it is not a vapour, but that it consists of particles. It seems most probable that these particles are living things—germs or spores; they are certainly organic and probably living. When we have got to know for certain that the poisons of this disease and of diptheria, a disease communicated in the same way, consist of particles suspended in the air, we begin to feel that we are not working so much in the dark. We begin to see how we can prevent those particles from getting into houses. We know perfectly well that those particles are contained in the air in the sewers. I understood Mr. Robins to say, at the commencement of his Paper, that a good deal of the modern practice of ventilation has been carried out for a considerable number of years, and I am bound to say I was very much astonished at that statement. Among the many hundreds—I was going to

say thousands—of houses I have seen in London there is not a single one (except those in which the drainage has been carried out quite recently) that is a healthy house in so far as the sewerage arrangements are concerned. I do not hesitate to say that most distinctly. I was about to refer to two other sets of experiments, by means of which we have been able to devize this system of ventilation or disconnection of the housedrain from the main sewers. They have been these: one has shown that foul gases will pass through water, that on one side of the water in a trap they are absorbed and on the other side given out, and that this process goes on continually, so that it is quite clear that if you have a water-trap in connection with pipes containing foul air, foul gases can go through the water. The other series of experiments are those of Dr. Frankland with regard to particles in foul air. He showed that when water containing foul matters, or any particulate matters, was distributed mechanically or by bubbles of gas given out by decomposition in the water, which is always the case when foul matters are contained in water, whether these particles were given out, by either of these methods, the particles were dispersed into the air above, and this became contaminated with them. These experiments show us what the water-trap will do and what it will not do. A water-trap will, to a very large extent, prevent particles, such as the poison of typhoid fever, from getting into a house, but it will not do so completely, because the particles may fall into the water on one side, and if the water is disturbed they may be thrown up into the air of the house on the other side. No water-trap will prevent foul gases getting into a house. Those are the results of scientific experiment, and I maintain without those results we should not be able to say that we can make a house perfectly secure from typhoid fever. We did not, I repeat, know of the existence of typhoid fever forty years ago. It was then separated from typhus fever by Dr. Stewart, a man now living, and we positively know more now about the ways in which it spreads, and how we can prevent it, than we do in the case of any other fever with which we are acquainted, smallpox alone excepted. We can put a house into the condition shown in one of the diagrams, and say with perfect certainty that if there is typhoid poison in the main sewer it will not get into the house, and with almost equal certainty that if typhoid fever is taken into that house it will not spread. It is not long ago since I was called to a large school where there was a case of typhoid fever, and where the sanitary arrangements had been carried out by one of our eminent specialists. My opinion was asked as to whether the fever would spread in that school. I looked at the sanitary arrangements and at the method of isolation adopted; I told them that in my opinion it would not spread, and that no other boys would get it unless they had already caught it, which did not appear likely. The authorities considered themselves justified on that report in not dispersing the school, and the result answered their expectations. That could not possibly have been the case five or six years ago—well say ten years ago, but I will not go a bit further back. It would have been impossible at that time to have said that this case of typhoid fever would not spread. I should like to say this also—to come to the carrying out of sanitary alterations—that although the principles by which these things are managed are perfectly simple, the putting of them in practice is almost infinite in its variety. It is one of the most difficult things one has to deal with, to go into an old house with pipes hidden in all sorts of extraordinary places, and wrongly arranged in the most perverse manner, and devize means by which that house can be put into an efficient sanitary condition without, I was going to say, pulling it down entirely,

so that although the principles of sanitary science are perfectly simple the practice is in many cases very difficult indeed; and to tell a person, as I positively have heard persons told, to go and read a book about sanitary matters and then try and put their houses in order, or tell a builder how to do it, is just about as absurd as if a person were to study a book about the methods of cutting off a leg, and then go and try and cut off one of his friend's legs. One of the most amusing things that ever comes within my ken is to come across a house where the householder has tried to remedy the defects himself. I suppose everyone here will agree with that statement. I will just mention one very practical point, and it has come within my knowledge over and over again lately, that in houses which have been apparently put into excellent sanitary condition, with a ventilating manhole, valve closets with syphon traps, all the overflows disconnected, &c., &c.—in such houses it has happened that there have been outbreaks of sore throat, diarrhœa, &c. (not specific diseases) distinctly and definitely connected with foul air. There have been several causes for that, but the cause which I have found most universal is that one simple direction has been overlooked in carrying out these things, that is to say, it is not sufficient merely to disconnect the wastepipes of sinks and carry them through the walls to end over gratings—that is not sufficient. The wastepipes of sinks are not proper places for air of any kind to come through into houses, and if you do not put syphon traps upon the wastepipes of sinks (immediately under the sink), you will have sewer sore throat and diarrhœa produced in houses by the fact that during the night a large quantity of the air in these houses has come into them through the insides of foul sinkpipes.

E. R. ROBSON, F.S.A., *Fellow.*—Speaking of the sanitary conditions of a house, I am very sorry Mr. Robins has not entered into the question of the level of the water in the land and the methods of keeping a house free from damp, for I believe dryness to be one of the most essential points in all healthy houses. Following the question of drains, I am quite certain Professor Corfield is right in what he says, and I do not think he need go further back than six or seven years without coming to a time when all houses were built in a more or less insanitary manner, not perhaps perfectly dry, without air to the drains and without ventilation to the rooms. One defect—the worst of all—is that the cisterns which supply the closets are almost always found to supply also the drinking water of the house, and to have their standing wastes in direct communication with the sewers. In my own experience of houses where I have been called in, I have found that to be almost always the parent of the disorders which have occurred. Everyone knows that bad water is the first and most prolific cause of typhoid fever, and Professor Corfield will agree with me that, although bad air is a cause, bad or infected water is the more usual cause. The point as to trapping the pipes of sinks discharging into the open air, which Professor Corfield has raised, is quite a new one to me, for I have never known a wastepipe discharged from sinks into the open air to be the means of generating sewer gas. Leaving the question of closets and coming to that of warming and ventilation, my impression is that those terms mean sunshine and fresh air as nearly as we can get both artificially. It is very difficult to control the pressure of the atmosphere as Mr. Robins seems to suggest, and it appears to me that all we have to do is to follow natural laws in the main. Natural laws in our artificial warming and ventilation have certainly not been hitherto followed. The open fire no doubt is the most charming way of warming a room so far as appearance goes, but it has the great disadvantage of being necessarily placed where it is least wanted. It usually warms

a wall which is already warm and not the window where the cooling surfaces are; and this is the usual artificial method of warming by the open fireplace. We should on the contrary put the heat where it is most wanted or most useful for checking draughts, and we ought to begin by making the halls and corridors thoroughly fresh and warm and full of fresh air—fresh air in the hall being the keynote to the warmth and fresh air of the whole house. I have, in connection with the London School Board, two schools both in process of erection, one being warmed by Boyd's Hygiastic Stove, and another on Leeds's American system, or low-pressure steam. When those schools are completed, I propose to communicate to the Institute some particulars and results of each method, so that Members may form their own conclusions. With regard to the use of any kind of steam, Members must remember the peculiar provisions of the Metropolitan Building Act, a most obsolete piece of legislation. In warming by the high pressure hot-water system, advantage is taken of an enactment intended only for low pressure, while in warming by steam there is no enactment except for high pressure steam, which is absurd. With regard to the use of the Tobin tubes it is perfectly true that they were suggested by Whitehurst in the last century, and indeed a copy of the book may be seen at the Patent Office, but Mr. Tobin has had the merit of drawing general attention to their great value. I do not agree with Mr. Robins in his size of the pipes or the position in placing them. My experience is that they may be made as large as 144 square inches and placed as far from the fire as you can get them, and that the trunks connected therewith (like all extract flues for foul air) should have as little horizontality as possible. Broad horizontal flues only create friction and destroy the effect you are desirous to produce. Another point on which I venture to differ from Mr. Robins is in relation to the inlets and outlets that air ought to have for ventilation. Unless you have an absolute exhaust for your outlets you must make your inlets considerably larger to produce the desired power, and you are always erring on the safe side if you err on that of fresh air. I differ from Mr. Robins also where he extols the air current passing from the lower to the upper part of the house. The dirty chambers below ground never will be clean, and the air proceeding through them, being vitiated at the outset, cannot be desirable for the upper rooms. The air you breathe, when produced by stoves placed in underground chambers, has the effect of making you languid and miserable. In a school heated from below ground I found in the course of an hour that the teachers complained of lassitude, fatigue and weariness. Therefore you come back to this, that unless you can apply your heat in a direct manner, just in the same way as sunshine heats the earth or the fireplace heats the room, you are wrong practically in all the results you want to produce. You must keep to direct radiation as a method of warming, which means that every radiating plan must be *in* the room and not in chambers below. I see some quotations from medical gentlemen who do not give us their formulas or their reasons, but they do give us their conclusions and their applications. I would rather that they would give us their formulas and so enable practical architects to apply them in their own manner. One gentleman talks of fresh air being admitted over hot pipes. Let us take a frosty day, one side of the pipe will be cold and another hot, and the consequence is that your pipe will very likely go to pieces. I think the air should never be admitted over the pipes. In conclusion I would venture to call attention to six books which would be of great value, at all events to the younger members of the profession. First there is Hood's *Practical Treatise on Warming Buildings by Hot-water,*

Steam and Hot-air; on Ventilation, &c. (the only scientific work on the subject), then Parkes's *Manual of Practical Hygiene,* Buck on Hygiene, Leeds on Warming and Ventilation, Galton on Healthy Houses, and of the many works on plumbing and drainage that of Hellyer is the best.

Captain DOUGLAS GALTON, C.B., F.R.S., *Hon. Associate.*—I think I should like to add to the books which Mr. Robson has mentioned that of Box on Heat, a very valuable work. There is a point referred to by Mr. Robson which is I think quite as great a cause of disease in many houses perhaps as sewer gas, and that is ground air. There are a great many houses in London which have been built upon very impure materials. The builders have taken away the gravel and the sand, and have allowed the site to be filled in with rubbish; when the site has been made up again to the original level they have then built houses upon it, and those houses have been notoriously beds of fever for years and years. I think Dr. Corfield will bear me out there. [Professor CORFIELD.—Certainly.] Ground air in towns is also liable to various pollutions from the sewers, which, when of brick, allow of a considerable percolation of air. I think it very probable that many of the evils which have been suggested as arising from the system of warming by means of a reservoir of air in the basement arise from the ground air being drawn in through the walls and floor of the basement, because when the air is warmed, it naturally causes a great indraught, and the air is taken up into the upper part of the house. This evil is noticeable in towns especially, and the question of the ground air is one to which architects cannot pay sufficient attention. They should endeavour by every possible means to cut it off from the house, because whenever the house is warmed in the winter the air will be drawn up from the basement through the house, and thus all these impurities pass up into the upper part of the house. The Paper read by Mr. Robins is one covering such an enormous extent of ground that it is quite impossible thoroughly to deal with it in one debate, and I am sure we owe the greatest thanks to Mr. Robins for having brought the subject in such a comprehensive way before the Institute. I have recently visited America, and I took the opportunity of seeing what is being done there in some of the most important systems of sanitary architecture. The American architects seem in many cases to have a greater scope afforded to them than is to be found in this country. I visited a church and a theatre in New York, where certainly the arrangements for ventilation far surpassed anything that has ever been suggested here. Perhaps it was owing to the scope given to the architect and to the fact that money had not been stinted in any way, rather than to any greater talent. If, in England, he had equal opportunities I should hope for equally good results from an English architect. The church I allude to is a Presbyterian church of which Dr. Hall is the pastor. It contains 2,000 sittings and is of course arranged so as to enable people to hear well, and hence they are in close proximity to each other; and there the ventilation is partly by means of propulsion and partly by means of extraction. It is beyond the limits of to-night to describe the system, but I only wish to say that, as regards both this church and this theatre (the Maddison Square theatre), the ventilation in both is carried to far greater perfection than anything at present done in this country. I was also very much struck with the perfection to which they have carried their system of heating by means of steam. The steam has great advantages in the high temperature which

you can give in a very cold climate like that of the winter of North America, but it also presents certain inconveniences. The advantage of the hot-water system over the steam is that you can regulate the temperature in your pipes to any extent you like, whereas with steam you have always the temperature of the steam; and although no doubt there has been a system adopted of working the steam at a low pressure rather the reverse of Perkins's system of hot-water, that is to say, you work the steam under the exhaust in order to keep it at a lower temperature, yet I do not think that that seems to be a very universal or successful arrangement. You always have in the arrangement with the hot-water a power by which you can regulate your temperature in your pipes to anything you like. In steam you must have a high temperature always, and it is very difficult to prevent the steam pipes from making noise, partly from the condensed water and partly from the sudden expansion of the pipes, &c. I think in this country, where we have no such great variations of temperature, it is better perhaps to adopt the hot-water system than to resort to the more economical system of steam heating. No doubt you can produce a greater result with a lower expenditure of fuel in one case than in the other when you have to do it on a large scale.

EWAN CHRISTIAN, *Vice-President.*—I can quite confirm one part of Captain Galton's remarks, for I attended the Church in New York, to which allusion has been made, one Sunday, when the external temperature was 76°, and I was never in a more pleasant place of worship; it was perfectly comfortable and thoroughly well ventilated. As to heating I saw, when at Detroit, the arrangements by which, for one set of engines placed by the river side, all the buildings within the radius of a mile were warmed by steam pipes to a temperature of 65° during a winter when the air outside was often 20° below zero; and not only were the houses, the stores, the churches, the theatres so warmed, but the lifts in the stores were worked by the surplus steam. It appeared to me to be a most admirable system for a country where the winter cold is excessive, but I do not think it would be suitable here. As regards house drainage, one thing has not been specially referred to, I mean Mr. Norman Shaw's system of soilpipes, and their disconnection from drains. I have myself tried it in a large house with complete success. The soilpipes are fixed on the outside of the house, and the air is allowed freely to pass through them from the bottom to the top, rendering traps unnecessary. I think it is an excellent arrangement. The information given by Professor Corfield, in connection with sinkpipes, is certainly new to me. I have for many years advocated the system of pipes from sinks discharging in the open on gratings outside, but have not found as a result of that system that the wastepipes have proved to be conductors of foul air into the house, when those pipes have been used without traps. I am inclined to get rid of traps where possible, excepting in the drains outside. There ought never to be a chance of foul air getting into a house from drains; every pipe should be disconnected, and all should be external. Then as to the passage of cold air through walls, much may be done to prevent this by the use of cavities; walls built hollow may be made perfectly strong by the use of courses of long and hard hollow bricks as bonders. Cavities, full of still air, are most valuable in equalizing temperature inside houses with external walls so constructed. [With reference to the question of cavities Mr. CHRISTIAN showed a rough section of a wall six inches thick. It represented the external walls of a cottage which he built some years ago in a very exposed part of Surrey]. The walls of that cottage are of timber six inches thick;

on the outside there are boarding and tiling; on the inside there is plaster. In the middle there are perpendicular fillets fixed on the uprights, and on each side of the fillets rough lathing and plastering, so that you have in that space three distinct cavities. That little cottage happens to have been inhabited by more families than any house I have ever built, because it has been let winter and summer for a number of years, and almost every person who has inhabited it, has borne testimony to its comfort, its warmth and dryness, and this I believe to be due simply to those blankets of air between the inside and the outside. Such a structure is both warmer in winter and cooler in summer than if it were built of solid walling more than double the thickness. I believe this to be a matter of very considerable importance in the construction of houses. To return to the subject of drains and bad smells, and the way in which the latter will travel all through a large house. I had a curious illustration in the early part of the present year. The Archbishop of Canterbury told me that there were some mysterious smells in his house at Addington, and asked me to try and discover what was the matter. I accordingly went down, looked all round the house, and found them very bad in several places, some at long distances from soilpipes or sinks. The cause was, however, soon discovered. There was no smell in the basement; the servants had no complaints below, but all the family were persecuted above. I found that the main drain was carried right underneath the centre of the house, and the soilpipes of the closets were connected with it from within. I found also that, from an imperfect joint at the floor level, the foul air was rising from the drains, passing up by the side of the soilpipe inside the house, and as all the walls were battened, it traversed behind the plaster to every room in which a fire was lighted. The defect was quickly corrected by taking every pipe and drain out of the house, filling the place of the latter with concrete, and sweetening the rooms by pulling down the plaster and clearing out the foul air which had gathered behind and clung there. I have my own notions about warming and ventilating, and as regards houses I do not agree with a great many of the schemes which are constantly propounded, because I have never in my own experience found any one which, within a year, was not got rid of. The generality of people will not tolerate ventilation openings in rooms. If there is a chance left of seeing a hole and the possibility of a draught from it, you may be sure that it will be stopped up; a duster, or something like it, will be stuffed into it, and all your science goes for nothing. The oldfashioned plan of opened windows and good fires in the grates is after all one of the best things to depend upon in our dwellings.

CAPTAIN DOUGLAS GALTON, C.B., F.R.S., *Hon. Associate.*—I should like to give one instance in corroboration of Professor Corfield's remark, that wastepipes from sinks delivering in the open air are liable to be foul. At University College Hospital there were a series of tanks for the purpose of providing fresh water in case of fire; nothing else but the overflow from those tanks passed through the wastepipe, and yet after two or three years those wastepipes became so offensive, although they delivered directly into the open air, that we had to provide traps to prevent the smell coming into the hospital. Yet there was nothing in them but the water which was delivered from the London water companies.

MR. J. G. SYMONS, F.R.S., President of the Meteorological Society.—With respect to the last remark, I should like to ask whether they examined those pipes to see whether a rat had got into them. [CAPTAIN GALTON.—A rat could not have got into them.] Nevertheless,

rats do very often get into such pipes, and we all know how fond they are of going after water. With respect to the list of books named I should like to add the Parliamentary Blue Book on Warming and Ventilation of Buildings (ordered to be printed August 25, 1857). It recounts the experiments tried at the old Board of Health on Richmond Terrace. With respect to the condemnations Dr. Corfield passed on the houses built up to the present time, there is one little thing to be thought of—we must not blame our ancestors. They acted up to their lights. It is simply that we have discovered better ways. The old ones are bad as compared with ours, but not bad as compared with the knowledge at that time. We have found out many things, and perhaps are going to live to a patriarchal age, but do we not proceed the wrong way to work? We first make the foul sewer air, and then discover means by which we may get rid of it. Perhaps we should be more clever if we did not make it at all. The blame must not be too much attached to architects on account of the old houses. Builders and not architects are responsible for a large proportion of them; and this leads to a suggestion I should like to throw out before the architects, which is whether it would not be possible to have some inferior order of architects?—if I may speak of such a being as an inferior architect. Take a case in point. I wanted to build a little office at the bottom of my garden. I was perfectly afraid to go to any of my architectural friends, for there would, I feared, have been a dreadful bill of fees. If I could have got advice cheaply I would have taken it, but I took counsel with a builder, and we stuck up something. Might not an architect have done a great deal better? and I am not at all clear whether I should not have saved money—perhaps I should. However, there is no doubt that as a rule an architect is looked upon as a very lofty and exalted being, who is rather beyond the run of ordinary mortals; and in consequence miles and miles of *things*—I won't call them houses—are run up, for which builders, not architects, are responsible, and which we must hope will not tumble down before the end of the time for which the leases are granted. With respect to the ventilation of large public buildings, Captain Galton is such a traveller, that he perhaps knows all about, and could better describe than I can, a plan adopted in Edinburgh. There is a firm in Glasgow (Pennycook by name), the head of which I on one occasion met; and he told me he was ventilating a room in Edinburgh, which was to seat about 3,000 people, and that he had done it upon a plan which to me was novel. It was that of having in the roof two large vessels, very much like two gasometers balanced over a couple of pulleys, and worked by machinery, so that one rose as the other fell. There were a series of valves, and directly the double gasometers were set in motion they were opened, and the effect was this: the air from the room was drawn into the one in order to fill the vacuum caused by its ascent. Then the motion became reversed, and the foul air taken from the top of the room was discharged into the open air. I do not know whether that plan is generally known to the Members of this Institute. It is independent of all questions of pressure and temperature; the weight of the vessels being balanced, you have simply to provide the motive power.

Professor Ayrton.—It occurs to me that one reason why science has not been more applied, in this new subject of sanitation, is because from habit we have come to regard disease as a natural state of things, like the common diseases of children for example, which every mother considers her child must have sooner or later; and better she thinks in early life than when the child has grown up. But that disease is, as I venture to think, unnatural, and a result of our want

of knowledge of scientific principles, does not enter her head. Consequently I think we must not trust too much to our sensations of what is unpleasant and unhealthy. May there not be much in a large town like London of a most unhealthy character, but to which we have become habituated, and therefore which escapes notice? This idea must especially suggest itself to one who, like myself, has travelled much. In Japan for example the people warm themselves with charcoal braziers without chimneys, and which therefore, in spite of the rooms being fairly open, pollute the air with a considerable percentage of carbonic acid gas and with carbonic oxide. But the Japanese from habit do not regard this atmosphere, in which an Englishman cannot live, as unpleasant, nevertheless the Japanese are by no means a healthy people in spite of their glorious climate. Again in America an Englishman finds the warming arrangements, whether it be the cast-iron or wrought-iron stove, the latter of which, when at a high temperature, is known to be porous to carbonic acid gas, very disagreeable. The American does not however notice anything unpleasant, but I would ask are the Americans a particularly healthy people? And may not the Englishmen of the future make some such remarks about our homes of to-day and talk about our unhealthy arrangements, to which like large doses of opium we had grown accustomed? With reference to the question of warming, it seems to me that just as at last we are beginning to imitate the sun for lighting, by using a few very bright electric lights to light up a large space, so in time we shall come to imitate the sun in warming our houses. As explained by Mr. Robins, the sun warms the earth by radiated heat, not by directly warming the air. So does an ordinary open fire-place warm a room. A room full of hot air is intensely unpleasant, the sensation after a sharp walk on a sunshiny frosty day intensely agreeable; we must therefore, I think, consider in what way our houses can be warmed by *radiated* heat in a more economic manner than at present. And the problem must not be regarded as an impossible one, because the solution does not immediately suggest itself to every one; twenty years ago it would not have been right to conclude that the artificial lighting of a large space by a single light could never be economically carried out.

Lt.-Colonel LENOX PRENDERGAST, *Hon. Associate.*—I think the attendance here to-night sufficiently shows the vast importance of the questions we have come to discuss, I hope that this matter will be taken up on another occasion, for we have two distinct matters before us—one Drainage, the other Ventilation and Warming, each of which is quite sufficient for a night's discussion. One or two things have been mentioned to which I cannot help alluding, and I am led to do so because nearly all those who touch the questions of warming and ventilation are very apt to forget the persons who are going to live in the rooms; moreover, there are often two or three sets of persons engaged at work on the arrangements of the same building. It is only a few days since that I happened to be going through the men's rooms in the new barracks at Knightsbridge, and I found this condition of things, in rooms warmed by that admirable grate of Captain Galton's: the rooms themselves were so intolerably cold that the wretched men were shivering, though three blankets had been given to them. All this has happened because you there have the doctors and the engineers to deal with, besides the architect and Captain Galton's grate! The doctors insist upon having the windows of a barrack at both sides of the room; but in the name of Fortune why are these windows to be as low down as three feet from the floor, so that the wind blows in upon the men in their beds? Why is the wall to be made of brick and nothing else?—seeing

the extent that wind passes through bare bricks. The result therefore is, in this case, that every extraction opening is closed! Such a failure appears to me to be worthy the attention of such an audience as this, and we should be able to put forward some formula by which these cross purposes between architects, doctors and engineers may be avoided. I venture to think there is another point in connection with ventilation which will be quite worthy of discussion, and that is the smaller matter of the houses in which we ordinary people live. There is a good deal said about churches, schools and hospitals, but it would be well to recollect that in this town we have a population larger than the whole of Scotland, and that we who live here are occupying houses which we did not build for ourselves. If these terrible stories, which we have been hearing, about bad drainage and ventilation are only partially true, the subject, I venture to think, is worth the attention of this Institute; we should devize, or at any rate discuss, the means by which existing dwelling houses may be made somewhat more in accordance with the principles laid down here to-night. I may mention that I made a small attempt in this direction some twelve years ago in my own house. We are all aware that it is difficult in houses with ornamental stone facings to cut openings for the admission of fresh air for ventilation, but I was anxious to supply air to a number of grates. I therefore built a tunnel under the whole length of the house, and utilized what are called "sweep flues," diverting them from their original purpose, to admit the air to some of the grates which were made for me with terracotta chambers. The air, being sifted at the mouth of the tunnel through strainers of paper-stainers' canvas, which go periodically to the wash, is not warmed in the tunnel, but passes direct to the heated terra-cotta chambers, and the atmosphere of the rooms so heated shows this plan to be a complete success. The foul air is extracted by its own chimney, for unless you have a chimney that does nothing else but extract the foul air of a room you are sure to fail; at any rate such is my experience. We must have the greatest simplicity in any arrangements that may be proposed in connection with sanitary science applied to existing houses, otherwise the tide of improvement in this direction will be thrown back. The public are already getting alarmed at the wholesale uprooting of everything required of them, involving the most serious expense, directly the drain doctor makes his appearance.

ADJOURNED DISCUSSION.

[Held on Monday, 17th January, 1881, John Whichcord, F.S.A., *President*, in the Chair.]

Professor T. HAYTER LEWIS, F.S.A., *Vice-President*.—Having moved the adjournment of the debate, it is my duty to offer a few observations upon the Paper, and in order to have the Discussion as exhaustive as possible, I venture to treat the subject in a somewhat different manner from that in which it has been already treated. I will assume that we have a town which, in regard of sanitary requirements as hitherto laid down (and in which I entirely agree), is perfect, namely:—1. That the soil and other offensive pipes are ventilated; 2. that the admission of foul air from the sewers into the housedrains is prevented; 3. that the sewers themselves have their foul gases carried off by ventilating openings; 4. that the storm waters are carried off by separate drainage; 5. that the smoke nuisance is altogether abated; and, 6. that the foul contents of the sewers are returned to the land in place of being hurried away from it to poison our rivers. Then, to take our own city as an example, we should have the following results. There are, I believe, about 550,000 houses in London, and allowing a due proportion of outlets for the soilpipes, drains and sewers, we may reckon, fairly well, upon having about a million and a half to two millions of pipes discharging their delightful contents into the air. I say nothing as to the æsthetic appearance of these pipes. They must be prominent, and yet one would scarcely suggest that they should be treated artistically, in such a way as would show their office. Anyhow, they must be dealt with, as all must agree that their presence is necessary, but I fancy that they would have an aspect not much more agreeable than that of those chimney-pots the appearance of which, at a recent Meeting of the Society of Arts, was eloquently dwelt upon by Dr. Alfred Carpenter. Now I cordially agree as to the necessity of this ventilation, but I wish in all seriousness to realize what the effects of the perfect ventilation would be. By the absence of the storm water, the contents of the sewers would lose the benefit of its oxygenating power and be still more foul than now, and however agreeable the absence of fog might be, we should be deprived by it (as Dr. Alfred Carpenter describes) of the carbon and sulphurous acid in the atmosphere, which are at present a part protection against the emanations from the sewers. I am of course quite aware that the air does usually rapidly oxygenate and purify these emanations; but it will, I think, scarcely be denied that, under some conditions of the atmosphere, the pouring into it continually of foul air and germs of disease from 1½ millions of foul air pipes would make it an unlikely kind of air for anyone to breathe: and yet this is the air which we *must* breathe. Now, this being the case, it seems to me that we ought to put before our engineering fellow-workers the necessity of aiding us by endeavouring to destroy in the sewers those foul gases which invade our houses or pollute the air. I will not venture to suggest a mode, but I am sure that this is not beyond their skill, and the method which General Scott has brought into notice appears to be, so far at least, a step in the right direction. In close connection with our subject come the system of earth-closets and ash-closets, the Rochdale system of pails, and other kindred systems; though they would probably lead into too wide a discussion to be attempted now.

Major-General H. Y. D. SCOTT, C.B.—I think that whether we adopt the so-called "separate system" (the only one which can be advocated upon sanitary grounds) or are contented to put up with the ordinary type of large sewers, rendered necessary to carry off a considerable

proportion of the rainfall and the subsoil water mixed with the liquid refuse from our dwellings, we must in either case run the risk of the generation of large quantities of sewer gas in the elongated cesspools which serve to convey away the polluted waters to the outfall. In the small sealed mains or iron pipe-drains which are employed in the ingenious pneumatic system, named after its inventor Mr. Shone, the danger from noxious gases is reduced to a minimum, and many of the worst defects of the water carriage system are, from the sanitary point of view, done away with. Even, however, under Mr. Shone's system, which may be regarded as perhaps the most perfect plan yet proposed of carrying out the "separate system," it is impossible to obviate entirely the evils of the gravitating sewers, as it is still necessary to provide large shallow-laid drains to take away the surface water, and under certain conditions it is well known that the drainage from courts and roadways is a far from pure and clean liquid. We may take it for granted, then, that under the water-carriage system, however it may be practised, it is impossible to obtain entire immunity from sewer gases and deleterious emanations; but it will no doubt readily be conceded that any plan by which the foul liquid can be deodorized, and the quantity of noxious gases reduced, is worthy of consideration. When the plan which is proposed for the accomplishment of this object has the further advantage of causing little additional expense, and has the effect of preserving the sewers to a marked extent from the slimy and adhesive growth or incrustation arising from the glutinous nature of the fœcal matters, and of preventing deposits on the bottoms and sides of the sewers caused by these incrustations, no one will deny the material benefit which would accrue from the adoption of such a scheme. Briefly, my proposal is to introduce the precipitants used to clarify the sewage, at or near the summit levels of the sewers, in the centre of the town, so that the sewage, in its passage through the town to the outfall, may become thoroughly mixed and incorporated with the chemicals, instead of receiving the necessary admixture of the precipitating materials at points remote from the town, at or near the outfall, as is at present usually the case. I assume that, for the purpose of dealing with the sewage, lime or some other cheap re-agent is to be added at the sewage works. All the change entailed by my plan is the introduction of the lime at several points in lieu of at one spot, and the contrivance of some simple plan of automatically apportioning the precipitant to the volume of sewage water to be dealt with. It may be thought that this plan might be liable to occasion a certain amount of deposit of the lime precipitate in the sewers, and it will occur to some that certain noxious gases would be set free by the lime; but the simple answer to such objections is that the plan was tried for several months at Ealing during the hottest months of the year without any evil effects. Not only was the smell from the drains greatly diminished, but the curdling action of the lime scoured and cleansed the sides of the sewers to such an extent that the scavengers stated they had never seen them so free from deposit. The action of the lime would obviously be to lock up the carbonic acid, which materially increases the tendency of the sewer gases to escape, and the sulphuretted hydrogen, which is one of the most active gases in causing the bad smells from the drains. The small volume of ammonia which would be liberated by the lime would be of trifling importance. The evidence of the officers at Ealing, under whose superintendence the above trials were conducted, was that the smell from the manholes and untrapped gulley-holes was greatly diminished; and the deposit and incrustations in the sewers totally disappeared under this mode of treatment. The plan adopted at Ealing was the introduction of the requisite quantity of milk of lime into

a sewer in the upper part of the town. This lime became mixed with the sewage in its passage down to the outfall and effected a very perfect and thorough precipitation, producing, as already seen, a great amelioration in the condition of the sewers.

MR. ROGERS FIELD, B.A., M.Inst.C.E.—I will confine myself almost entirely to the question raised by Professor Lewis, which seems to me of the greatest possible importance. In fact, it goes absolutely to the root of sanitation. If I understand his question it comes to this: If you have all your sewers and housedrains thoroughly ventilated, you will have a million and a half of ventilating pipes in London emitting foul emanations and poisoning the air, and he asks is this to be the be-all and end-all of sanitary science, or ought we not rather to find some means of destroying the foul gases in the sewers? Now I entirely agree with Professor Lewis that some means of preventing the emanations ought to be found, and I think a little careful consideration of the question will show that it is perfectly easy to prevent them. What do they come from? Foul gases arise from the decomposition of organic matter. Wherever organic matter is allowed to rest so that it decomposes, there you will get foul gases. If this is true (and I believe every one admits that it is) all that has to be done to prevent any considerable accumulation of foul gases is to ensure the immediate and complete removal of all foul matter immediately it is produced, so that there may be no time for it to decompose. That is to say, that you must so arrange all your drains and sewers that everything is washed away immediately. Now this proposition is so extremely simple that there is great danger of its paramount importance being overlooked, yet if you consider it a little in detail I believe you will find it goes to the root of the whole matter. First of all, there is the question of the public sewers, and as this is more of an engineering question I will not further allude to it than to say, that if sewers are properly constructed, properly flushed and thoroughly ventilated, you will have practically no smell from them—no appreciable smell. Where you get the smell is where the sewers do not carry the foul matter away, where it remains, and where it decomposes. It is, however, a great mistake to imagine that foul emanations (which unfortunately do exist, and which are generally called sewer air and sewer gas) come exclusively or principally from sewers. They come quite as much from defective housedrains. I have had in my practice very striking instances where foul smells have arisen from ventilators and sewers which were attributed to the defects in sewers, but which on investigation were found solely and only due to defective housedrains, and which were cured directly those defects in the housedrains were remedied. It seems, moreover, to be generally agreed that in a well-designed system of house drainage there should always be a system of cutting off the housedrains from the sewers, so that the air from the sewers should not get into the housedrains. All you have to do, therefore, is to deal with the housedrains themselves, and if you can make these so as not to retain deposit you have got over the difficulty of the foul emanations. Now this is perfectly practicable, though I cannot say it is easy, as there are a great many points to be attended to. Housedrains and all the arrangements connected with them must be made *self-cleansing*, and this can only be effected by very careful attention to all the details. In order to make the drains self-cleansing they must be of a proper size, have sufficient fall, and be truly laid. It is a mistake to make drains too large, because small drains are often the most effective. Some years ago I was asked to advise respecting the drainage of a large house at the West End, where there had been a death from diptheria. The drains had been laid by an eminent builder not long before. They

were 9-inch drains and they had a 9-inch syphon trap between them and the sewer; this was completely choked with foul matter and the sewage all blocked back. I recommended the alteration necessary, but it was not convenient to have the work done immediately. I had the drains for the time being thoroughly cleaned out, and some weeks later the house was handed over for the alteration. I then opened the drains and found that the 9-inch syphon was as nearly as possible blocked again. I took the drainage up and (as there was a good fall) for the 9-inch syphon I substituted a 4-inch syphon, and for the 9-inch drains I substituted 4-inch drains, and from that day to this there has never been any trouble. The syphon has kept free and the drain too. Of course I do not mean to imply by this that 4-inch drains should always be used. There are, however, very few cases indeed in which it is advisable to use 9-inch. Now as to the fall, no hard and fast line can be laid down; but I may say that the fall, which seems such a favourite one with the builder, and is even sanctioned by some architects, of $1\frac{1}{2}$ in 10 feet is, as far as my experience goes, quite insufficient: you ought to have at least double and if possible more. Of course I am speaking of drains under ordinary circumstances. If self-acting means of daily flushing are adopted, the inclinations of the drains may be greatly reduced. I have often laid 6-inch drains at a fall of 1 in 100 and 1 in 200, and at the present time I am laying a 9-inch drain in a large mansion in the country with a fall of 1 in 330, flushed by one of my self-acting syphons. Last but not least, then, is the question of laying the drains, and the important point is that the drain should be truly laid, both as regards line and level. This is not at all as simple as is generally supposed; if the drains are laid in curves, as is so often done, it is almost impossible to insure their being truly laid. The only way to ensure accurate work is to lay them in the manner pointed out by Mr. Robert Rawlinson, namely, in straight lines from point to point; it is then easy to lay the drains truly, and the least error in line or level can at once be detected and remedied. This system has the further immense advantage that, by providing manholes and inspection chambers at proper points, the drains can be examined, and if necessary cleansed at any time without breaking into them. This question of providing ready means of access to the drains, without having to break into them, appears to me to be one of the greatest importance, and to be too often overlooked; the drains must also of course be made water-tight, and they should be actually tested to see that they are so. It is not however sufficient to deal with the drains, for if you neglect the apparatus all your labour will be in vain. The water-closet apparatus must be self-cleansing, that is, the flush must carry everything away. If foul matter remains, then decomposition is a sure result. There are many kinds of traps that will always retain foul matter: the D-traps, which are unfortunately in such common use, are terrible offenders. I will give an instance which occurred in my practice years ago: I had made openings at the foot of a soilpipe, and there was very little smell in the drain, I then had the closets removed and some water poured down the branches of the closets to test what the condition of the soilpipe was, and the smell was abominable; we had to run away from it. I repeated the experiment several times with the same result, and came to the conclusion that the soilpipe was very foul and must be removed. Before doing this, however, I had the D-traps removed which were attached to the branches, and the water then poured down the branches, when to my surprise there was absolutely no smell, showing positively that the smell was simply and solely due to these D-traps. If you had adopted any of the modern methods of disconnection without removing the D-traps you would have had

that abominable smell at the disconnection opening every time the closets were used. The pan-closets are also so constructed that they cannot flush themselves; the defects of pan-closets and D-traps are now recognized by all the best authorities. These closets and traps are forbidden by the Model Bye-Laws of the Local Government Board. In the United States they are paying great attention to that question; at Memphis, which has lately been so successfully sewered by Colonel Waring, pan-closets and D-traps are forbidden; the plumbers laid in a large stock of them but the authorities made them take them all away. There are a number of other closets which retain foul matter, in fact any closet which has not a proper flush will do so; the difficulty now is that there are such an immense number of contrivances, that it is difficult to say what is good or what is bad. I think the Sanitary Institute of Great Britain is doing good service in this way, because at its annual exhibitions it will give no prizes to water-closets and similar apparatus without actual trial: architects will do well, therefore, to look up the closets which have received prizes from the Sanitary Institute. From what has been stated it will be seen that to make the whole of the drainage arrangements self-cleansing requires skilful design and careful attention to details, but it is well worth spending time and trouble on, as the result is that foul gases are no longer generated and the ventilating pipes no longer send forth foul emanations. So true is this that by smelling at a ventilating pipe one can generally tell whether the drainage is good or bad, a bad smell from the pipe being a sure indication of some defect in the drainage. This I believe to be the real solution of Professor Lewis's problem. I should like to confirm what Professor Corfield said, that if drainage is carried out according to modern sanitary principles you can prevent typhoid fever from spreading in a house. In addition to the case he quoted (the details of which I know, as the school was drained under my superintendence) I could give you another—a Collegiate Institute, in which typhoid fever was introduced from outside, but did not spread. In both these cases the drains were very freely ventilated, and many of the ventilating openings were on the ground level. I cannot agree with Mr. Robins that the principles now insisted upon by sanitary science were carried out by architects many years ago. It seems to me that the open air disconnection of all soil and wastepipes was a new point of departure. When I commenced that, five or six years ago, there were all sorts of practical objections, the chief of them being that the open disconnection would create an abominable nuisance and would block up with frost. The nuisance question has been settled, as it is now proved beyond doubt that there is no nuisance if the disconnection is properly carried out. The freezing question can only be determined by experience. In 1878-9, the most severe winter we had had for 40 years, I recorded my observations on considerably more than 100 open soilpipes and disconnections, in a letter sent to the *Builder* (March 1st, 1879). From this it will be seen that in only one case was there any trouble from frost. Mr. Norman Shaw gave his experience in a letter to the *Builder* (Feb. 15, 1879). Mr. Eassie gave his in the *Sanitary Record*, and Mr. Buchan has recently given his with reference to his open disconnecting trap, of which large numbers have been fixed. The whole of this evidence was to the same effect as mine, and I think therefore we may conclude that open soilpipes and disconnections, if properly carried out, will not suffer from frost in this climate, unless placed under very unfavourable or exceptional conditions.

Mr. J. WALLACE PEGGS, Assoc.-M. Inst. C.E.—The general principles involved in house drainage are very simple, and when once we have mastered these the special details of each case

will easily be worked out. The great point to attend to is that all drains shall be self-cleansing and not drains of deposit. This is effected by giving proper gradients to your drains and making them the proper size—not too large—as the former practice has been. In our older towns and cities where we had "sewers of deposit," it was very essential to block off a house entirely from the sewer system, and this was achieved by open-air disconnection of all drains and by placing a trap on the housedrain between the house and the public sewer. In a well devized system of house drainage and public sewerage there should be a continuous flow from the house to the outfall of the sewerage system; namely the drainage from a house should never be allowed to rest at any point, but deliver at the outfall in a few hours after leaving the house. The great point of departure in house drainage was when the soilpipe was disconnected. The disconnection of sinks and bath wastes was of course practised many years ago, but the soilpipe disconnection has only been adopted within the last few years. Professor James Thompson as early as 1866 disconnected the soilpipe of his own house by delivering it over a stoneware gully. The open-air disconnection with ventilation of soilpipe was very early dealt with by Mr. Rogers Field, and he has given us the beautiful arrangement of the disconnecting manhole. By this arrangement you have perfect control of your housedrains ranging forwards to the public sewers and backwards through the house, so that any stoppage is at once dealt with without the expense of breaking open the ground.

Mr. Robert Rawlinson, C.B.—Before making some general remarks I beg to state briefly that I think, with regard to modern drainage, I can claim some credit for the systems that are being adopted at present, namely, small drains laid in direct lines with manholes or lamp-holes at changes of line and gradient. This mode of working was introduced about 1850 by Mr. Hugh McKie, one of the most intelligent assistants I ever had. I made the first drawing of the moveable manhole cover. These covers were first made in Lancaster and have been generally adopted. It has been said by one of our most eminent civil engineers, the late Robert Stephenson, that for any man to know his mistakes is the readiest way to correct them, and with the permission of the Chairman I will mention a few mistakes in housedrains that have come within my own observation. For instance it has been customary, and it may be so now for anything that I know to the contrary, for large houses to have drains laid within the basements. I can refer to a house that has been built within the last half-dozen years in which there was a drain and a bell-trap in every cellar throughout the basement, and the main drain outside had cesspools along its line, to intercept and retain the effete matter that came away from the water-closets. On this outlet sewer there was no provision for ventilation, the consequence being that the house, although it was new, upon occupying, became unfit to live in. This is an example of one form of mistake. The remedy for that state of things was to have the drains in the basement pulled up, and the bell-traps removed. Those drains it was not convenient to pull up were filled solidly up with cement concrete. All the sinks, and places where water had to be passed away from the building, were carried to outside walls. The main sewer was stopped short outside the walls and there ventilated, the pipes from sink were passed through the wall to empty over receiver on outside drains. Of course all the cesspits were emptied and filled up with cement concrete, and ventilators were put on manholes, so as to permit the gases to escape to the open air. Another case, Dunrobin Castle, the seat of His Grace the Duke of Sutherland: the castle stands on a beautiful site overlooking

the sea; it is drained, and some of the drains run through the buildings. It is, I think, four years ago (it was in the autumn) the Duke requested me to go down. I went, and found that some of the water-closets within the castle had been closed and papered up. They had had the house full of company part of the autumn and the stench had proved so intolerable that many of their guests left. On examination I found that the main outlet drain from the castle to the sea had a good fall, but that this sewer, as in the other cases, had deep cesspits along it, and over each cesspit was a shaft up to the surface, which the clerk of the works had, during the summer, most carefully covered and sealed up with cement, so that the foul gases which had partially escaped before were closed up and had then no outlet but to and through the drains, sinks and water-closets connected with them, which made the place simply unbearable. After I found this state of things I had every one of those cesspits uncovered (at first I had not time to cause them to be emptied), and told the housekeeper to unpaper every closet, leave the windows closed and then to go into every closet in the house at midnight and tell me in the morning what she found. Well, in the morning she said, "I have been into the closets and they are every one as sweet as possible." I then took his Grace and showed him the openings in the line of sewer, where all the tops were off, and explained that as the sewer gas could not get readily out into the open air, it consequently had to go into the castle. The remedy, I explained, consisted in having the cesspools emptied, filled up with concrete, and permanent ventilators put over every shaft where it came to the surface. The main sewer of the castle was continued to a considerable distance beyond where a ventilating shaft was placed in the plantation in the open air so that no gas could remain in that sewer. The closet soilpipes were also ventilated and some other little things done, and from that day to this there has not been any further complaint made to me, and I do not suppose that the alterations cost his Grace more than £150. I will now draw attention to what ought to be the condition of houses and drains where you have to begin at the beginning. I have come to this conclusion, namely, that it is not necessary to have sewers and drains within houses, however large the building may be. If you have a building to design as large as the building which I am now in at Whitehall, it need not have one single sewer or drain beneath it. I say deliberately that it is not necessary, if the architect takes thought beforehand, to have sewers or drains within the four walls of any building however large it may be; and he should also see that all his gutters, and his roofs and everything connected with them, are arranged in such a manner that he can get his outlets where it is not necessary to put his drains within his basement. Then there is another rule, which both the engineer and the architect should bear in mind from the beginning: it is, that no portion of his work should ever be done in a way that it is beyond his reach for examination and repairs, or that he has something serious to pull to pieces for repairs. He should so plan, arrange and construct, that he or his successor will be master of the position, and, as Mr. Rogers Field has told you, without disturbing a single brick. This is possible and quite easy upon sewers and housedrains which have been laid in right lines, and have the other arrangements already referred to. You can then examine what a sewer and drain is doing, by having moveable manhole covers. A correct record of all branches and junctions of sewers and drains should be made and preserved, and thus you will remain master of the position. With regard to the ventilation of sewers, the letter that was read only

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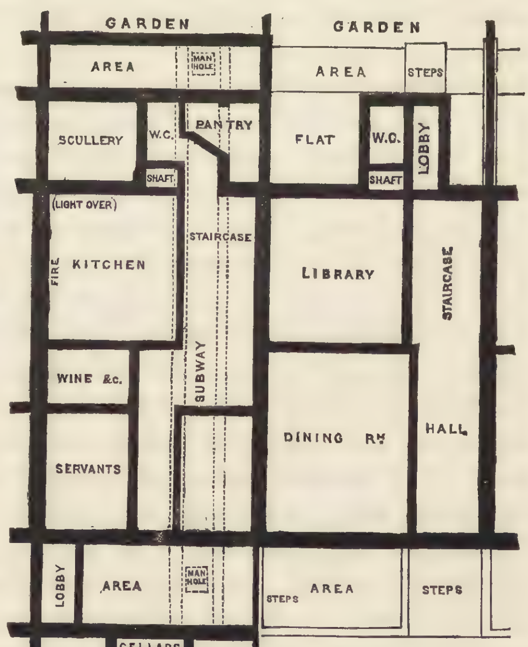
shows how dangerous a little knowledge is. London is held up as an example of defective sewer ventilation, but if London is an example in one way let it be taken all round. It is an example, a marvellous example, of the largest aggregated population in the world enjoying the best health, but it is by no means perfect in its sewerage. There are many miles of sewers just as bad as they can be, and the most difficult and worst sewered part is in the west—that is, Belgravia. The sewers there have upright sides, flat bottoms, and they retain deposit. The main sewer that comes out of Marlborough House is about the worst of them, and was, and probably now is, swarming with sewer rats, and the grit deposit never comes out of it, except when severely flushed or removed by hand labour. Now that state of things is not necessary, even on a flat surface, as the inverts may be improved and self-acting flushing tanks of adequate capacity may be provided; and if London is not sooner or later dealt with by a system of regular self-acting flushing, the main drainage may prove (some scorching dry summer) to be a curse instead of a blessing, because it will carry away that volume of water which would have diluted the deposit and rendered it comparatively innocuous. It is possible by self-acting tanks to establish a system of automatic flushing. The volume of water required would not be anything very serious after all, because 1,000 gallons would flush the largest housedrain in London. Now with regard to emanations. These, as Mr. Rogers Field has told you, are due to the corrupting of the deposit retained in badly formed sewers that do not evenly and regularly deliver the sewage, but either allow the fluid to soak away and leave the solid matter to accumulate, or the sewers are too wide or too irregular to admit of the volume of water poured in carrying the crude sewage away; but, with all that, and bad as they are (and Professor Corfield will correct me if I am going to say anything wrong), the air in these large sewers is singularly free from taint. I remember the British Association meeting at Liverpool, where a chemist said that the air in every main sewer in London which he had tested he found purer than in the room that he was then speaking in to the section; in consequence of the abundant open street ventilation. That mode of open street ventilation is nevertheless constantly being denounced by persons who do not understand it. They say that the openings stink. Well, no doubt some of them do, when they are too few and imperfect, but do away with them and what will become of London? When sewer ventilators stink in the open air, as they do, it is a minimum evil. I admit that they should not stink, but it is a thousand times better than that you should seal them up. At the beginning of the century when sewers began to be made in London generally and water-closets were introduced and the sewers were totally unventilated, they became so foul that men who went in to cleanse them were killed as if they had had a dose of prussic acid; typhoid fever broke out in the houses situated in the streets that were drained and connected with the unventilated sewer. To avoid these risks from water-closets, drains and sewers, in the future, Acts of Parliament were passed for preventing housedrains that had water-closets being connected with the sewers. Hence came the construction all over London of cesspools which you find now in the basement of old and especially of large houses. In Gwydyr House, Whitehall, appropriated for the first general Board of Health in 1848, they found nine cesspools all full. Any large London house that is a century old will generally be found to have cesspits on the premises, because the Acts of Parliament in that period forbade the communication of water-closets with the sewer. In 1844 even Windsor Castle had 53 cesspools, within or upon the premises, all full and

overflowing. Now, the first regulation in any town is that the sewer shall receive and remove the contents of all water-closets. I am not going to argue whether closets are in all cases preferable to the dry-earth system or the wet-earth, that is, tub system. Anybody has my consent to use such apparatus. But the best are only half measures. Imagine London turned into a dry-earth system or moveable pail system, and see what would be the consequence. Each house would have one or more small moveable cesspits within it. The householder would be tied to an external agency to remove it, and wait till that agency took the excreta away, and there would be not only the materials to remove but the weight of the apparatus backwarks and forwards. At Rochdale the pail system is carried to the greatest perfection, and the Town Clerk and Surveyor inform me that the money loss to the Rochdale people is from £10,000 to £12,000 per annum, although they were getting from £3 to £4 per ton for the manure they manufacture. We are found fault with, when towns are on the sea shore, for throwing crude sewage into the sea, and as true political economists this will be the proper mode if it is to cost thirty shillings for a sovereign to be returned. At Edinburgh, on one side of the city suburbs, the Craigintenne Meadows, sewage is used in irrigation, bringing in large money returns, but on another side, from the Water of Leith, an equal volume of sewage is, at a first cost of about £80,000, sent by a cast-iron outlet to sea. System of sewering on the modern principle is an economical principle, because instead of laying down sewers at £2, £3 and £4 per lineal yard, you can lay them down at shillings per lineal yard, which will take the sewerage, and the cheaper sewers will be the best. The Americans have taken up the question of small sewers for large populations, and have carried it further than we have ever ventured here, by sewering a population of 40,000 with an outlet sewer of two feet diameter, the principal sewers in the main streets having 9-inch and 6-inch sewers and 4-inch house drains, with a self-acting flushing tank at the head of each block of houses. They tried small sewers to remove waste water and excreta from houses, shutting out all surface water, before they began the sewering of Memphis, and found it answer. As stated, they confined their sewer drains and sewers to taking household waste water and excreta alone, shutting out the surface water and letting that go off the surface, taking the crude sewage away into the river. If self-acting flushing tanks are judiciously placed and regularly used, I have no hesitation in saying that, for all time after, those sewers and drains will be preserved clean. I can point to Lord Spencer's house in St. James's Place, and I can undertake to say that every drain would be found, by anyone inspecting it, to be clean. To secure the continuous safe-working of sewers and drains, the cross sectional dimensions should be small. The materials used should be sound, and in form, lines and gradients, there should be absolute truth. All earthenware pipe sewers and drains should joint evenly and should be made air and water-tight. One defective joint may cause much mischief and discredit work otherwise good. As to dimensions of sewers and drains for large houses, the outlet from Alnwick Castle is a 12-inch earthenware pipe having six branches of 9-inches, 6-inches and 4-inches diameter. A 12-inch pipe, having a good fall, will deliver 200,000 gallons in eight hours.

Professor Kerr, *Fellow*.—It is very plain that engineers have provided us outside our houses with a most pestiferous system of sewers; and whatever curative measures are necessary outside our houses we must expect the engineers to contrive and adopt. But there is no necessity for introducing into a house, whether it be a large house in the

country or a small house in town, any of those prodigiously complicated appliances with which we are surrounded, and which are perfectly bewildering; to my mind they convey no expectation except that of an interminable vista of increasing trouble and complication, a continual succession of attempts to get rid of false conditions, and a continual succession of failures. The course that I should adopt if I were called upon to lay down a plan for making an ordinary house healthy would be this :—that there should be no water-closets inside the house, no pipes, no plumbery of any kind. It is only a very few years since there was no such thing as a water-closet inside the house, nor a pipe. It is these ingenious gentlemen themselves who have produced all this complication. It is within my own recollection and, Sir, of yours that the system of "scientific plumbing," as it has been called, has grown up to be only an ever-increasing source of perplexity; and when we hear of such things as a multitude of water-closets to be "tried" for prizes in an exhibition, and a great deal more, I can only ask, where will it all end? I cannot pretend to describe to the audience to-night how I should propose to deal with a house on a large scale, because it would take too long a time. I have brought down a drawing in order to shorten my remarks.* I will describe to you what I think would be a very simple mode of dealing with the still more important case of ordinary London houses. To begin with, it is of no use to tell us that we must not put a drain under the basement. We must take London as we find it and this is how we find it. There is a sewer running along the front of the house, and we must drain into that sewer; the water and the gas are delivered



BASEMENT. GROUND FLOOR.

* The intention is to illustrate the general idea of the proposal, without going into details. The case assumed is that of an ordinary London house of simple arrangement, with two rooms on the floor. A small annexe is placed at the back, in such a position as to render it accessible from the staircase, and leaving space on each side for the windows. An upright shaft within this annexe would run from the basement floor to the roof, with an escape for air at the top. The annexe would contain all the water-closets, the bathroom, all cisterns, and the housemaid's sinks and draw-off taps. The shaft would then accommodate all vertical pipes whatever—water pipes up and down, wastes, soilpipes, gaspipes, the heating circulation, perhaps the rain-water pipe; and the ventilation of the kitchen, and perhaps of the principal rooms, might be accomplished by its means. The sinks in the basement would be close to it, and the kitchen boiler not far off. The subway under the basement floor is supplementary to this shaft. It would contain all the horizontal continuations of the pipes from the shaft to the street, and also the housedrain. It would extend from the usual open area in front of the house to an open area at the back, and at each end there would be a manhole for access. The vertical shaft might be of sufficient size to allow a workman to ascend and descend within it, or access to it might be had from the successive stages of the annexe. If sufficiently warmed by the hot-water pipes, or by gas-burners, the frost would not affect the pipes. Of course the gaspipes must have branches under the floors, and so might the water pipes; but the less of this, the less risk of inconvenience. R. K.

at the front of the house. My plan is to provide an annexe for all water-closets, &c. at the back of the house, with a vertical shaft to contain all pipes, and a subway from back to front under the basement for the drain, the pipes, and whatever else. First we must have a thoroughly air-proof bed under the house. I cannot go into this question at the moment, but it is now fortunately made matter of statute, and provided then that all obnoxious appliances are put in the annexe at the back and quite separated from the house, what more does the house want to make it perfectly wholesome? On the subject of heating and ventilation, I would only add that if we would consent to do with a little less of this heating, and wear a little more clothing, and keep windows occasionally open instead of always closely shut, I think we should be more healthy than we are. Although I am quite aware that in this country no impression can be made upon the public without a considerable amount of exaggeration, I would deprecate the very great amount of exaggeration which is imported into this question of house sanitation at the present day. All these tales about typhoid fever, I say plainly, I cannot believe. I have never met with an instance yet in which fever could be clearly traced to drainage such as an architect would put in. But I am anxious to admit that foul emanations from the sewers ought not to be allowed to get into our houses on any consideration whatever. I also cordially agree with Mr. Rawlinson scientifically on the importance of ventilating sewers by openings in the streets everywhere. If people do not like the smell, this cannot be helped: it need not be very offensive and need not be at all noxious.

Mr. BOXALL GRANTHAM, M.Inst.C.E.—I am now draining an old Roman town with streets 12 or 14 feet wide; in other parts of it the streets are a fair width, but it is by no means easy to ventilate the sewers in the narrow streets. The plan adopted is to carry up the ordinary ventilating shafts in the streets, but eventually I believe we shall be compelled to construct ventilating shafts up the sides of the chimney stacks. With regard to the treatment of sewage at Ealing by General Scott. A Committee of the British Association was formed, and as I was the Chairman of that Committee I had the opportunity of investigating that question. The process for a long time caused a separation of the matters in suspension in the sewage from the liquid, and clarified the water, but only at great expense, and the experiments could not be continued. The materials used in the process were clay and lime, which were afterwards burnt into cement.

Dr. GEORGE V. POORE, F.R.C.P.—Let me say a word as to Professor Kerr's plan. The method of putting all the sanitary offices in an annexe is a good one, but why should it not be in front of the house instead of at the back? If there is a disagreeable part of a London house it is the front. There you get all the noise of the streets which makes the front rooms almost uninhabitable. Now an annexe in the front is capable of being treated æsthetically, and I hope, if we are to have an annexe, it will be at the front nearest to the sewers, and not at the back and farthest away from them. One of the speakers said that he did not believe sewer gas caused typhoid fever. I am sorry for any gentleman who has that belief. In connection with such matters I may be allowed, perhaps, to state what happened to myself three or four years ago. I was called to one of the great public schools to see a boy who was living in a master's house—a new house—and who had been attacked with pneumonia. On examining him I came to the conclusion that it was secondary to typhoid fever. It turned out to be so and in a few days, unfortunately, the boy

died. I said, "Let us go over the house and see if we can discover any cause for this," because the master had told me that another boy had died some months before, and that there had been other cases of inflammation of the lungs. He took me to the place where the boy had slept—a dormitory on the first floor. He slept in a cubical in the dormitory. A sink was there close to the foot of the deceased boy's bed, and the first question I put was, "Where does the wastepipe of that sink go?" "Oh!" he said, "that's all right, that goes through an outside wall; it is cut off and it opens over a wide trumpet-ended ordinary water-pipe, so that there can be no smell back from the cesspool." "Let us go outside," I said. We did so, and by the light of a lantern, for it was night, we could see the soilpipe disappear inside the top of the water-pipe. We got a ladder and found that the wastepipe of the sink emptied itself into this water-pipe and the two pipes were tightly cemented together so that the wastepipe of the sink went directly into a cesspool. Above this dormitory was another dormitory, and above the sink on the first floor was a sink on the second, and these two sinks emptied into a common pipe. The fall of water from the top sink probably emptied the trap of the second sink, so that boy had been sleeping literally with his nose almost over a cesspool. Whether that caused his typhoid fever or not it is impossible to say, but the probability is immensely in favour of the theory, and all would allow the sufficiency of the cause. I quite agree that our houses should not be complicated in their sanitary arrangements. If we could go back to the days of Abraham, who shifted his camp at frequent intervals, we should know nothing probably of typhoid fever. I do not think, however, that the ladies of London would subject themselves to the simple sanitary laws of Moses, and I am afraid water-closets in the interior of houses have become an established system, so that the question we have to consider is how not to be killed by our higher civilisation. With regard to the statement that the air of London is antiseptic, I think that is very much open to question. I doubt if a respirable air has any antiseptic influence over the germs possibly floating in the air; and supposing it has, I do not think we can point to London as a city particularly free from germs, for we in the medical profession see our full share of those types of disease which are called zymotic, and which are presumably spread by means of germs, such as typhoid fever, scarlet fever and diphtheria.

WILLIAM WHITE, F.S.A., *Fellow.*—Mr. Robins ought to have connected his Paper with architects rather than with civil architecture, because his treatment of the question has rather gone upon that; and at the Sanitary Congress at Exeter there appeared to be an attempt made by several medical men and engineers to fasten upon architects as such the responsibility of various mistakes which had been made in the carrying out of some very important works. It would ill have become me to have replied with the *tu quoque* argument, "You gentlemen are capable of doing the same thing;" but still in defence of my profession I did feel and think it well to say that I knew of certain cases in which an architect, in order to avoid the responsibility which they knew in certain cases attached to the architect, threw the whole of the sanitary arrangements into the hands of engineers and medical men. The result was a total failure. Really, as a fact, it is no discredit to my own profession, or to engineers and medical men, or other men of science, to admit failure. In reference to what Dr. Poore said, it may be interesting to know that at the present moment I have just completed in my own house very much the same kind of thing as suggested, and Dr. Poore would know why the closet

could not be in front, from the very fact that he is my neighbour occupying the whole of my back wall. Nevertheless my closet being on the staircase there was no possibility of putting it elsewhere; and leaving it there, I was obliged, in order to meet the difficulty of the drainage, to have the pipes, which ran down necessarily through the house, taken up and relaid. But I brought the soilpipe down under the basement into the area with a ventilation opening 5 or 6 feet from the floor. It is also carried upwards above the roof and left open at the top. But then I isolated this 4-inch ventilated soilpipe within another 9-inch ventilated stoneware pipe, which I terminated in the same manner by a separate opening to the top. These pipes are inside the house and I have, in both of them, found a strong and constant upward current. I am satisfied that this arises from the pipes being entirely within the house, so that they do not get chilled. I have been told of an instance where, in an exposed situation, pipes have been put externally, and have had to be moved inside again on that very account. I do not insist on this as a necessity, or say that an outside pipe is a mistake. The most serious question with us is that there are so many diverse opinions upon all these matters that the whole subject of sanitary science is at the present moment tentative and experimental; and that is the reason why many of those principles which are laid down by one and another, as most invaluable and certain, are not so decided in various men's minds. A friend of mine, who is very strong upon sanitary points, tells me that he believes the old pan-closet is really after all as good as any; the only thing he would insist on is that it should be properly burnt out once a year—a good prospect for the plumber whatever it may be for the householder. And there will always be great difficulty in influencing public opinion so long as the very worst appliances are advertized in the same pages side by side with the best. How can the public distinguish between the merits of the respective apparatus when such variety of opinion exists amongst men of science here and at the Institution of Civil Engineers, as well as in the Medical Societies?

LIEUT.-COLONEL JONES, V.C., Assoc.-M. Inst. C.E.—I regret very much the way in which this debate was opened by Professor Corfield. He exalted the science and *spécialité* of sanitary drainage, and said that householders ought to have nothing to do with this work themselves. I think, with regard to the aim and object of all sanitation, that the knowledge of it should be spread as widely as possible; that it is matter of common sense to admit plenty of oxygen, to purify all foul air, and as soon as possible to disconnect the house from any communication with sewers outside if possible. Sanitary Science has very simple principles, and the more we cloud them with too much counsel, the worse it is for the real aim of sanitation. If it is to be for the prevention of sickness it should be made as widely known as possible what a very easy matter has to be treated. If it is to be made the aim of deep science, and people are told that only scientific men are to deal with the subject, I think we shall not make the progress we otherwise might if we put before people the main facts, and asked them to take some interest in the matter. In cases where I have been called in I have found the greatest assistance from eliciting the intelligence and knowledge not only of the householder himself, but even of his servants.

ADJOURNED DISCUSSION.

[Held on Monday, 14th February, 1881, John Whichcord, F.S.A., *President*, in the Chair.]

HENRY DAWSON, *Fellow*.—It has been proposed to restrict this evening's discussion to the subjects of ventilation and warming; and this seems most desirable, inasmuch as the previous evening was exclusively occupied with the subject of drainage. But seeing that, on that evening, the majority of the speakers were engineers, and the opinions of architects upon some of the important statements were, from want of time, imperfectly represented, I ask permission, just for a few moments only, to refer very briefly to matters of drainage, which I will put more in the form of an addenda to that evening's debate, and not so as to provoke further controversy, which would encroach upon the time set apart for the special subjects of this evening's discussion. As to the alleged superiority of small over large bore sewers and drains, still insisted upon by some of the engineers, I think to a dangerous degree, I will mention the following fact of recent experience with which I am intimately acquainted, namely, that the town of Croydon, less than thirty years ago, was sewered throughout its main thoroughfares with small diameter pipes; but these sewers for the last ten years have gradually become so inadequate to convey away the sewage and refuse of the town, that the whole is now in course of reconstruction, and for the main lines they are laying down cement concrete sewers large enough for a man to crawl through. The most urgent improvement at present needed in our sewers is the easy removal of the chief cause of the deleterious gases which are generated there, and if this is to be done by the aid of some precipitant, such as lime, as suggested by Major General Scott, how can we with safety adopt the small pipe sewers? Again, the solvent power of rain water renders it so valuable an agent for cleansing the interior of sewers, that it should make the engineer hesitate to adopt (except only partially) the separate system of sewers for rain water and sewage. As to house-drains, some of the engineers have told us that a 4-inch pipe, with a fall of 1 in 30 is, in general, amply sufficient for the main drain. I must say I think this to be most dangerous advice, having regard to the frequent difficulty in London and large towns in getting a quick fall, and more especially to the frequent presence of those obstinate obstructionists, such as cloth remnants, hair and grease. My experience teaches me that for any dwelling larger than a six-room cottage a 6-inch main pipe is the least which should be adopted. The production of foul gases through deposits in housedrains originates almost invariably not from the size, but from their unsound beds, irregular gradients and abrupt junctions; and I would urge that the only practical prevention (albeit an onerous one) of this common neglect of workmen is a rigid inspection by the architect, or his responsible deputy, first, of all the trenches before the pipes are laid, and a second inspection of pipes before any filling in. I will, also, refer to two dogmas which have been unsparingly insisted upon by some modern sanitary doctors. 1st. That "no drains should be laid under the house." I submit that the inapplicability to the majority of urban dwellings of this otherwise salutary rule has been well shown by Professor Kerr and others; I will only further urge that if, in addition to the excellent practice of laying down the main drain in a straight line from back to front of the house, with manhole at each end, there could be in all ordinary houses a flushing tank of say 100 gallons,

fixed in the annexe about 10 feet above the head of the drain, and its contents passed through the drain every week, there would be a practical security against all decomposition therein. The only serious hindrance to the general adoption of this weekly cleanser might be the insanitary regulations and exorbitant charges of the Water Companies. 2nd. That "there should be no trap inside the house in connection with wastepipes, especially where the ends are open to the air." The error of enforcing this direction in the case of sinkwastes was well shown to us by Professor Corfield. But I would urge that the error equally applies to the soilwastes of water-closets, not only on account of a similar liability to the ingress of foul air from the unclean coatings of the pipes, but also of the frequent inconvenience and bodily injury arising from draughts of cold air through the overflow pipe of the water-closet pan. The old but useful warning, reiterated by Professor Corfield, that no water-trap will necessarily prevent the passage of foul gases, can only of course apply where there is a sufficient pressure of air in the drain on the lower side of the trap, and this pressure will not exist where there is ample ventilation and sufficient cleansing. With regard to ventilation. It may, I think, for our present purpose be most simply and comprehensively defined as the operation which secures a free and constant, but gentle, circulation of air through the interior of our dwellings, or of any apartment occupied by human beings, and by which the exhalations from their lungs and bodies, as well as the products of combustion from artificial lights, are regularly removed by the pressure of a constant inflow of pure fresh air from the external atmosphere. I cannot agree with Mr. Robins's classification of the methods of ventilation, which he describes as either "natural" or "scientific," because I hold that the system which is most scientific is the most natural: that is, it is the simplest and truest application of natural laws. I submit that the two distinctive methods in use would be more correctly defined as "natural" and "mechanical" ventilation. By the former method, the air of a room is set and kept in motion through the simple process of its rarefaction, by some heating medium near the floor, whether it be an open fire, or that given off by hot water pipes, and which cause it to ascend to the ceiling with the heated products of respiration and combustion to be carried off by extraction flues, and as a necessary consequence, compelling a corresponding inflow of fresh air into the lower stratum of the room to be warmed in its turn, and to ascend and escape as before. Whereas by the latter method, or "mechanical" ventilation, the fresh external air, after being warmed, is propelled by some artificial means into the room, and the vitiated air is extracted by the exhaustive process of revolving fans, or a steam blast, or the suction of a powerful furnace flue. I may say that I am no advocate for the mechanical or artificial method, because I think it is only suited to extraordinary buildings, and that the instances of its success are rare, doubtless from the difficulties in ensuing an equable temperature and velocity of the air. We shall all agree, I suppose, that the chief difficulty we have to surmount, even in the "natural" system, is to change the air by continuous circulation without violent currents or unpleasant cold draughts; and in discussing the means which are best adapted to prevent these frequent concomitants of ventilation, we have at once to consider the available methods of warming. Unquestionably, the open blazing fire is the most cheerful and genial, and therefore, notwithstanding its wastefulness, it will probably continue to be in demand, as indispensable in our British homes. But, although it must be admitted that its past use in the majority of our dwellings has been attended by chilling draughts from the windows and doors, I

cannot agree with Mr. Robins that these draughts are inseparable from the use of open fires; on the contrary, I maintain that it is quite feasible to avoid them by giving to each room its separate supply of fresh external air, which shall be sufficient both for the purposes of combustion and the recuperation of the internal atmosphere for respiration, and so render imperceptible any ingress of cold air through the window crevices. But then it is indispensable that this fresh air supply shall be capable of being warmed (when required) to a moderate temperature before it enters the room; and this can easily be accomplished in ordinary-sized sitting rooms by using the heat from the open firegrate itself—all that is needed is a slight modification in the usual register stove having fireclay linings to the grate, a warm air chamber formed round the back and sides of the stove, through the bottom of which are properly proportioned inlets for fresh air, and at the top on each side is an outlet flue for the warm air which is made to enter the room about 2 feet 6 inches from the floor, and at such distance on each side of the fireplace as may be found most convenient. I may add that the warm air stove, &c., such as I have here described, and which I have used in considerable numbers, was originally made and arranged from my own design, because I found that those which were offered me were either too complicated, costly or clumsy. For the completion of the ventilation of ordinary dwelling rooms, as well as of schools and like buildings, which shall possess the means of conveying away the hotter vitiated air as it ascends to the ceiling, I have made still further use of the waste heat from the open fire by carrying up two vertical extraction flues on each side of the smoke flue, about 11 inches by 9, all made in single pieces of hard burned terracotta, 2 feet wide and 2 feet 8 inches long. These flues have openings just below the cornice, fitted with Boyle's or other self-acting valves, and their extracting power may frequently be increased by conducting the heat from gaslights direct into them by double tubes through the thickness of the floors. The adoption of this simple method of warming and ventilation in my practice has been attended with good success, not only in dwelling houses, but even on a larger scale in halls and schools, and in one church where I really was allowed my own way. While treating of the interior of our dwelling houses, I would urge very strongly that one great *desideratum* in most of even our modern houses is a due supply of fresh warm air at moderate temperature, through the hall, staircase and corridors, at all times during the winter months. Seeing that these intersecting channels of the house are the feeders of air to the rooms, and especially to the bedrooms at night, I think nothing can contribute more to the health of the inmates, particularly those who are liable to catarrh, than such a constant renewal of the internal atmosphere; and it also prevents cold draughts through the doors of sitting rooms. I have been particularly impressed with the value of the system adopted at the Long Room at the Custom House by Mr. Boyle. I must give my testimony that his air-pump ventilators are really so constructed as to act like air-pumps. They do exhaust the air in the top, and my impression is that they are most useful, and may be made very valuable for the extraction of foul air from large buildings. To say, however, as is so frequently said, that there is never any down draught is saying too much, and when I went up there to examine the system, I found that the outlet tubes instead of being as described—carried up straight from the ceiling direct through the roof—have a bend in them, and in that almost horizontal bend is placed a contrivance for the purpose of checking any little down draught, and there is also a little

receptacle for soot. As to the admission of fresh air by vertical tubes from the floor, it is available in large halls, and where high enough no doubt with success. I believe Mr. Robins states that he considers it particularly suited to a room with an open fireplace, but from that opinion I must entirely dissent. I think there can scarcely be anything worse than an ordinary room with an open fireplace, into which cold air is admitted by a tube of that sort; and for this reason, that the in-current of cold air must be drawn towards the open fire, and so inflict chills upon the occupants, and this conviction scientifically based has been quite confirmed by experience in two instances. At the particular request of clients (but against my advice) the system was tried, and in both cases it most ignominiously failed. It failed, as I said it would, from the fact that the cold air—unless the room is at least 20 feet in height—has a rapid upward direction to the ceiling and is sure to descend again at a low temperature on the heads of the persons in the room, more especially if there is a large open fireplace. At the time that this system, popularly known as Tobin's, was first loudly trumpeted in some of the public journals, the public were referred to the rooms of the Society of Arts as an instance of its application, and I accordingly went there a few days afterwards to ascertain the results. The late Mr. Le Neve Foster was then there, and upon my asking him what he thought of the new means of ventilating his room, he replied that, although the ventilators had of course relieved the room of its former closeness, yet ever since they had been put in he had been scarcely free from rheumatism; he said he had moved from one side of the room to the other to escape the current of cold air, but it was impossible to do so. Other instances, where I have known it to have been similarly applied, have been attended with the same complaint. But there is another serious ground upon which I submit that this attempted method of ventilation is palpably unscientific and bad in its operation, which will appear evident when you reflect that these columns of cold air are forced up to the ceiling, to mix with the warmer but *vitiated* stratum of air; and the impure mixture then descends continuously to be breathed into the lungs of the persons who have previously expired some portion of it. Therefore, although I admit that this system gives a means of purifying the atmosphere of a room in some degree, where there is no other fresh air supply, yet I must regard it as a most imperfect system anywhere, because it introduces the fresh air at the wrong level, with the evil results I have just described. In very large halls, and even in churches, it may sometimes be introduced with impunity or no great harm, but I do submit that the more natural system of bringing in the fresh air at the bottom and carrying it over such a heating medium as hot water pipes is a far more scientific, effective and healthy plan. With regard to the Custom House I found that the fresh air tubes (about 6 feet from the floor) were covered over with ledgers, and I asked them why this was? "Because we feel a draught," was the reply.

J. P. SEDDON, *Fellow.*—I must disclaim having taken any very active or deeply scientific part in the present movement for sanitary reform. Had I any claim, it would be perhaps due to the letters which from time to time I have written, during spasmodic fits of indignation, to the *Times* in vindication of the architectural profession when charged with ignorance of, or indifference to, this important subject. When outbreaks of typhoid fever occur and some person of eminence has succumbed to them, architects are invariably made the scapegoats for defects due to inferior builders, to whom the public trust blindly the construction of houses, as to which architects are comparatively rarely consulted. Nevertheless though we architects

thus suffer unjustly, we cannot but rejoice in the sanitary crusade that is in progress, trusting that, sooner or later, justice may be done to us, and that at any rate some good may result from it to the community. So we welcome the interest which very recently has been shown in the matter by members of the medical profession, as the public will listen to them, though deaf to us who have piped to them still longer in the same strain. We may, however, be allowed to smile a little among ourselves at the tone assumed by a few gentlemen, somewhat savouring of the zeal of new, if somewhat tardy, conversion. Smiles, nevertheless, yield to frowns when we see inventors, as they consider themselves, adopt appliances well known to us if not to them, and who, forgetting that even the Greeks symbolized oxygen as Minerva, try to tax the admission of that goddess or her representative into our dwellings. I wonder whether it would surprize such learned gentlemen to be told that a discussion upon the practical ventilation of buildings was held in this room eighteen years ago. A glance at the remarks then made, and published in our TRANSACTIONS, would show them that architects, even then, were alive to the grave importance of the subject and had devoted, before then, much time and attention to it. Nevertheless it is a matter for unmixed congratulation that now more minds and other professions have sanitary reforms under consideration; that fresh information is being gleaned, that rules and regulations are being laid down and enforced to give practical effect to theory. The few remarks which I have to offer, on the present occasion, I will arrange under the four ancient, if empirical, elements of *earth*, *air*, *fire* and *water*, dealing, as time is scant, with general principles rather than with details in each case. To begin with *Mother Earth:* As has been pointed out by others the isolation of dwellings from immediate contact with her bosom is essential. This should be secured over the whole interior area of buildings as well as of their walls; the damp-courses in ordinary use suffice for the latter, but I think more stringent measures than usually adopted are needed for the former. I am and have for years been in the habit of allowing no spaces under ground floors, but concreting up to the under surface of the boards, leaving no room for vermin, and obtaining ventilation elsewhere than from where it can hardly be fresh and sweet or dry. A saving in cost of excavation of steeper walls is so effected, and the only danger anticipated, namely, dry rot to the timbers embedded in the concrete, I have not encountered. Upon this point I should be glad to hear the experience of others. *As to Air:* I should wish simply to recapitulate some remarks which I made during the discussion in this room already referred to, in 1863,* several years previous to Mr. Tobin's alleged invention. I then said that I must join issue with gentlemen who had spoken as to the position of openings for the admission of air. It seemed to have been assumed that this must be either at the bottom or top of the rooms, but I suggested that it should be near the middle. Not long ago a physician (Dr. Bird, now deceased) called my attention to the way in which his rooms were ventilated in considerable volumes through a bracket 6 feet from the ground just, above the level of the heads of those occupying the apartment, with an upward direction. This he contended was the only proper method and position for admitting fresh air, no small quantity of which was needed to supply what was extracted by the fire, and which entering from any other point (except the fireplace) usually causes unpleasant draughts. Undoubtedly, I then said and say now, in my opinion the best point for bringing cold air into a room is at so high a point as to blow over the

* See the report of Mr. Seddon's Speech in the TRANSACTIONS, 1862-63, page 132.

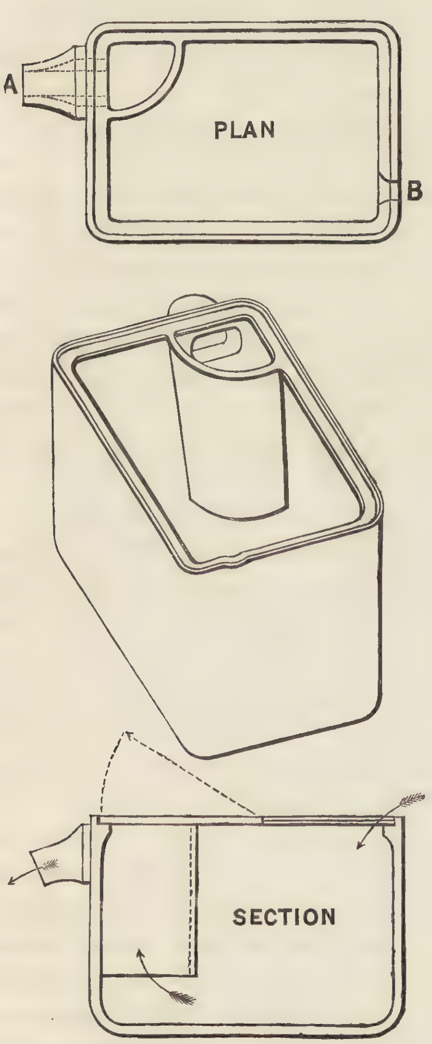
occupants and at as low a point as possible to secure that condition. But that if the air be not cold the case is different. I went on to contend then and I contend now, that every fireplace or warming apparatus should be made a fountain for the admission of air at a moderate temperature. I will summarize my views on this point by asserting that it is as necessary to lay on air to houses as water, and by other means than through the soilpipes, actually the only pipes which do admit air to nine houses out of ten when the windows are shut; and that the fireplaces are the best places for its admission to prevent draught, as even from Tobin's tubes cold air makes a short cut often to the fire, to the annoyance of those in its course. Still I will not quit this subject without acknowledging that much is due to Mr. Tobin, short of the tax he would impose for having gained the ear of the public where others before him have failed to do so. There are now so many excellent appliances for the purpose of bringing air around fireplaces that it is needless to specify them, all that is wanted is to get the public to use them. *As to fire:* I have myself made many efforts to reform grates and other appliances, but I have found all that I have aimed at so perfectly fulfilled by what has gained the name of "The Wonderful Stove,"* an invention of Mr. Samuel Russell, that I have suspended my own efforts in the hope that he would be able to bring out his grate, which in my opinion only needs care as to its artistic treatment. In this invention the fuel is inserted into a receptacle arranged in the mantel above the fire and spreads itself as required over a bright fire, by which all smoke is consumed. *As to Water:* The great essential is freedom from contact with foul drains. This is now so universally acknowledged that it only requires the experiment of regulations perfectly agreed upon. I do think, however, that a great evil as to our water supply is hardly suspected, and that in fact some advertizements are so misleading that I would in conclusion make a few remarks on this subject, and detail a dispute I have lately had with a so-called Water Purifying and Filtering Company. It having been suggested to me by my brother, Major Seddon, R.E., that my annual payment to such Company was unnecessary, I had several samples of water taken from the same cistern, both which had passed through and which had not passed through that so-called sanitary appliance, a filter, changed every other year. The result was that the filtered water proved the worse of the two. Subsequently I invited the Company to experiment with me on the contents of a filter in a similar condition, belonging to Sir Rutherford Alcock. The results corresponded with that above recorded, and a further result was that both Sir Rutherford Alcock and myself had our respective filters removed and not replaced. The fact is that charcoal, though useful perhaps for a short time for filtering purposes, soon loses under such conditions its purifying powers.

CHARLES FORSTER HAYWARD, F.S.A., *Fellow.*—In contributing to this discussion, I would observe that the practical side of the question is the one which architects have chiefly to consider; and the necessity of their applying true principles in daily practice makes it the more needful for them to be careful in enunciating any doctrine as being exactly and always perfect, while experience shows them how even a perfect theory fails often in its practical application. It fails, not necessarily perhaps from inherent want of correctness in principle, but rather perhaps from its leaving out of account some of the special circumstances with which

* A full description of this Stove, given by the inventor, is printed in the PROCEEDINGS, 1880-81.

an architect as a practical man has continually to deal. Though this may make it all the more desirable for an architect, to be from time to time reminded of the true abstract principles up to which he must endeavour to work, it is nevertheless a reason why the architect should hesitate where a theorist, or an enthusiast would rush on, for an architect often sees at a glance some defect in the chain of argument or its application to the ventilation, warming and drainage questions, which less practical men accept as indisputable dogma at once. Reference has been made to the old system of ventilation and drainage (or the want of it) which has been stated to have been utterly bad; but it is in a great measure the same which, after all, is now being pointed to as scientifically correct, and mentioned as if a new discovery had been made. The new discovery consists rather in the fact that where we have, in recent times, departed from some of the old arrangements we have been wrong, not that houses were never ventilated nor healthily drained before the era of the modern water-closet. True, it was a "haphazard," or shall I say "natural" system—if system it may be called—which our forefathers adopted before the introduction of socket glazed pipes made it possible to carry drains safely (as it was thought for a time) under and through house-floors, and before the present scientific water supply made it safe for a house to have water-closets and slop-closets, permanently fixed inside a building. The old or natural plan with the sink water was the letting it run unimpeded through the scullery wall into an open grating to some near outlet, also open to the air and often too visible; but these outlets or reservoirs of filth were not generally domed-over cesspools, as they subsequently became; they were *thoroughly ventilated by the open air.* They did not form close stills, whence all manner of evil and dangerous nuisance emanated. Now the importance of the ventilation of these improved cesspools, being unknown, this *ventilation* was the thing which was neglected, and the modern discovery is that it must follow with any system of improved drainage, and it is just what we are aiming at in our open air gratings and ventilated gulley-holes. Moreover, the doing away with water-closets where possible in favour of earth-closets only reminds me, and I dare say all others at my period of life, of home experiences as a boy when water-closets existed not, but when ventilation to such places as there were was most unimpeded. Now where we can in the country we revert to the principles embodied in these old arrangements though in an improved form, and find ourselves to be scientifically right according to recent theories. Yet we have been accustomed in the meanwhile to laugh at such simple arrangements as wanting in modern enlightenment, and have built water-closets, D-traps and drains, carefully sealed (and recently carefully unsealed and ventilated)—only to abandon them for something like the old unimpeded ventilation—when we can see any substitute which promises better without the old disadvantages, though often indeed developing some of its own. We see then that ventilation cannot be separated from drainage, nor can one be touched without discussing the points of the other. And the ventilation of drains is perhaps the most important point of all, while the draining away of bad air is as essential as bad water, and comes to the same thing in the end. The town and country differ much of course, but in all cases I adopt the same motto—"Divide and conquer"—that is always, where you can, divide your drainage system into (1) sewage, (2) slop, and (3) rain waterdrains. It is astonishing how these have been, and often still are, mixed up together in one confused mass of pipes and traps. Keep control of each and you will conquer most difficulties. Field's flushing tank will

be most valuable for flushing, where it is wanted and can be used, but at present it is rather costly. The great difficulty is the dealing with the greasy water, and a really good grease trap is the one great want. Other traps have been made, but a really effectual vessel for collecting hot water charged with grease, and straining it off cold, leaving the grease itself congealed, floating on the surface to be easily skimmed off or picked out, has not been invented, to my knowledge yet. Nor have all my efforts to substitute some contrivance for it succeeded fully hitherto. It is well known that this grease water is liable to hang to almost anything accidentally flowing with it, and is sure to be foul and offensive. Yet it is quite a valuable commodity—(I believe one eating-house pays its scullerymaid's wages entirely out of it)—and if only an effectual trap could be used that would make it possible easily to collect the skimmings, and so worth the while of the scullery servants to do so, there would be some chance of the matter being attended to in the generality of households; but while it is simply allowed to run away to some drain to fester and obstruct, I submit that there is something scientifically wrong and wanting a practical remedy. I may say, of course, we all have some remedy, but I want a perfect and universal one. I have invented and used a slate undersink on wheels with a bent syphon tube—only to see it neglected and thrown aside because the servants would not trouble to use it. I have a fixed galvanized iron one in use now—an interceptor box I call it—but it fills up soon and wants constant attention, and though it saves an immensity of foulness from going through the drain, it does not entirely prevent the necessity of frequent cleansing at the open air outlets not far distant. I should like to learn what others do to meet the case. In town, of course, the flushing out of the open air drain, sending all the grease, &c., into the sewer as soon as possible, is the only plan adopted, and Field's tank and grease trap before alluded to may be, and doubtless is, very useful in this. I know of nothing worse than large grease traps —generally unventilated—allowed to accumulate filth—sometimes even under the kitchen floor—and I have had to have them removed in such neighbourhoods even as Grosvenor Square, Mayfair, Piccadilly, &c., and showing a most frightful condition of things long existent. So now, I have tried to design, and with the help of Messrs. Doulton to execute, a common grease *trap* (in the proper sense of the word trap—where what you catch you can keep yourself) or interceptor-box, applicable to all buildings



and for everyday use; and here is a model* of it, on which I invite your criticism. The object is simply to catch, or intercept, the hot greasy water, and give it time to cool so that the grease may float on the surface, while the water runs away from a lower level and discharges in the usual way over an open grating or gulley. This is in common earthenware, and would cost about as much as the sink itself, or a little more. It can have an iron grating, a wooden or wire top, or have no covering whatever—can be fixed inside or outside, under or beside, the sink, being quite independent of it, and of course can be added to any sink now existing; and its use will obviate the necessity of the built traps so frequently required. In all cases as I have said, separate this water as much as possible from *slops,* as generally understood, and this again from the outcome of soilpipes in every way. I need not enlarge further on this, but simply observe that the problem is often entirely different in the town and the country, as well as in the practical application of the principles here stated, even when the problem happens to be the same. One point I would lay down strongly is that a drain is not a thing to work for ever, or even for a long time, without some supervision or inspection, and as even the granite steps of a house will wear away, so assuredly will the component parts of a drain, and require repair; and unless care is exercised when undergoing repair, the whole principle of action may be reversed, and what was good at first be eventually bad in every respect. Thus the want of some good sanitary instructed foreman (say, technically educated, in the modern phraseology) is greatly felt, and there ought to be some special class of men well known to be skilled in ventilation and drainage work whom an employer (say a builder) can engage for the special job to take up and superintend the drainage works, as each foreman of other trades does his own special department. It is of little use for an architect specifying the best kind of drainage works when the builder or his foreman, ignorant of the principles and details of the work, cannot see to its being properly done. I have recently suffered from this myself, and I dare say others can understand the difficulty I allude to, almost having to do the work oneself, or to stand over the drains for an hour or two at a time. My next point is the ventilation of, or rather the drainage of, foul air from the sewers. The drainage of foul water into the sewer is of course one thing to be done. Supposing, however, the drainage into the sewer properly done, why should the *drainage back* of foul air into the streets, and houses if it can get in, be allowed at all? But this general scheme of sewer ventilation combined with smoke extraction, would deserve a long chapter to itself, and I cannot further pursue the subject now, but I look forward to the day when it will become a reality, and so solve many of the present difficulties of town drainage. As regards ventilation of rooms and houses, that is "atmospheric recuperation," as Mr. Robins puts it, I may observe that I look forward to a self-acting system in the shape of a ventilator—both inlet and outlet being worked by a sensitive apparatus—such as is in actual existence in conservatories, and which could have been seen not only at the late Exeter Sanitary Exhibition (where it gained a medal I am told), but at the Agricultural Exhibition at Kilburn. By this or some other simple means of adding and extracting air according to the temperature of the apartment, so much can of course easily be done, and at the times when fires are necessarily

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* Diagrams of this model are given on the preceding page. In the section of this grease trap or interceptor, the arrows suffice to indicate its action; in the plan, the entry is at B., the exit at A.

in use much greater facilities are offered in the process. Why should we pay to get rid of foul water and yet have to take back, if we cannot bar it out, the foul air generated in the sewers? In a word, why not attack the evil at the sewers themselves? The question whether the sewers should be publicly ventilated, instead of privately at each man's expense, and sometimes against his will (and remembering the millions of pipes referred to in Professor Lewis's remarks), requires, and is at least worthy of, discussion. There are certain spots that I know of where the sewers are ventilated into the pathway, near a certain square, which would enable my nose to tell me where I was if I was blindfolded. I venture to say that, as the ventilation of mines is a scientific study there is every reason and need to make this subject of sewer ventilation a scientific study also—and the subject of the ventilation of the main sewers of a town, and how best to do it, a subject of serious discussion. The one great remedy against foul return gas is to have it all properly drained away out of the sewers, and the draught created *away from* the houses and inlets instead of as now *towards* them. If the current of air was directed towards certain public ventilation shafts, with fires beneath them consuming, not only their own, but the smoke of the adjoining neighbourhood, which should be drained into them through the flues—the heat generated might serve for motive power to effect the electric lighting of our streets and houses.

Professor AYRTON.—I hope Mr. Dawson will not think me unsound, even if he thinks me unorthodox, if I propose to consider warming quite apart from ventilation. The two things, warming and ventilation, although both in winter performed by our open fireplaces, ought to be as distinct as lighting and ventilation, which again in summer are both left to one agency—the window. From the absence of glass, you cannot look out of a Japanese house without opening a sliding door and letting in cold air, and you cannot keep out the rain without at the same time shutting out the light. Partly from this, any attempt to warm the Japanese houses has, in spite of the severity of the winter, not been carried out. We have in England emerged from the state of trusting at night to the fire-light to see by, just as in towns we have abandoned the plan of each man pumping up water from his own well. Let us then advance a step farther, let us recognize that ventilation, warming and lighting are three quite distinct things, to be carried out by three distinct agencies. We are now sufficiently familiar with supplying water as well as artificial light, or gas, from centres; can we not then bring ourselves to contemplate the supply of warmth as well as the supply of ventilation from centres, each quite distinct from the other? That the ventilation of a crowded public building should, as is frequently the case, depend on the whims of the people near the windows—whether they are to be open or shut—is as ridiculous as it would be if the people nearest the gasburners had the right of turning them off and plunging the rest of the audience into darkness. A continual supply of fresh air in a room which shall be independent of wind, of percolation of air through the walls, as well as of diffusion through open windows, can be effected in one or other of two ways: 1. by propelling the air into the room through proper orifices; 2, by extracting the air. In the first case, the air in the room is caused to have a pressure greater than that of the atmosphere, and consequently it has a tendency to flow away by any openings it may find. In the second case, the air in the room is caused to have a pressure less than that of the atmosphere, and air tends to enter the room by any possible inlet. In the first case, we have full control of the entering air, since no air will enter the room by

open doors or badly-fitting windows, or by any other orifices than those provided for this purpose. This is a consideration of some importance, but it is more than balanced by two others, namely, that a fan when propelling air seems, according to Burat, to give only three-fifths of the effect that it gives when sucking it out, and again when air is propelled into a room the whole supply passes through the propelling arrangement, and there may be great risk of the freshness of the air being destroyed with such an arrangement. Mr. Robins has told us that 3,000 cubic feet of air should be supplied per hour for each adult, although practically only about 750 are furnished, and it is not difficult to arrive approximately at the power necessarily expended to produce such an inflow. When air is set in motion, it tends to lose energy by friction, and the loss of energy in a passage through which the air is passing is proportional to the cube of the velocity, so that if the velocity be doubled, the energy that has to be supplied by a fan or chimney to maintain the flow is eight times as great. Again, the loss of energy in a passage is about proportional to the length. Any bend, or sudden expansion or contraction, or any obstruction, considerably increases this loss, the addition depending on the character of the alteration produced in the streams of flow, the suddenness with which the paths are altered, and the increase of velocity. Without venturing to inflict on you any mathematics, the expressions for the loss of power can be written down so simply that I venture to give the formulas my friend Mr. Perry and myself have arrived at and employed in such calculations. To maintain a flow of Q cubic feet of air per second through a flue l feet long, A square feet in section, and having a perimeter or circumference of c feet requires an expenditure of nearly—

$$\frac{l \ c \ Q^3}{10{,}000{,}000 \ A^3} \text{ horse-power,}$$

a result that can be easily remembered. If for example we wish to maintain a flow of 10 cubic feet per second (which is Mr. Robins's full supply of fresh air for 12 adults) through a pipe 50 feet long, one foot in diameter, about three-hundredths of a horse-power must be expended; whereas if the diameter of the flue be reduced to half a foot in diameter the expenditure must be increased about 30 times, or about one horse-power will have to be used, a result which shows the extreme importance of large pipes. The formula for the loss of energy the air undergoes, on entering and leaving the pipe, can also be equally simply expressed. If, for example, the total area of the pipes bringing air into the room be A square feet in section and similar extract pipes be employed, and if there be no enlargement nor contraction of the pipes at their ends, there will be an additional loss of energy of about—

$$4 \frac{23}{10{,}000{,}000} \ \frac{Q^3}{A^2} \text{ horse power,}$$

which for the supply of 10 cubic feet per second amounts, for pipes having a total sectional area of one square foot, to about one-hundredth of a horse-power, or for pipes of half the diameter, to sixteen times as much, or nearly two-tenths of a horse-power. The subject of ventilating by chimney draught seems to be somewhat misunderstood even by practical men, which is the more unfortunate as the calculations on the subject are quite simple. The motive power in a chimney simply, of course, depends on an ascensional force possessed by each cubic foot of hot air, and which is equal to the difference between the weights of a cubic foot of hot and cold. But the effective work got out of such an arrangement is very small compared with the waste of heat necessary to warm the air, and the following

calculations, which Mr. Perry and myself have made, show this fully. If Q cubic feet of fresh air are to be made to enter a room per second by a draught in a chimney h feet high, in which the temperature is maintained at $T°$ Fahrenheit, while the external temperature is $t°$, the horse-power usefully expended by the chimney is—

$$\frac{7}{10,000,000} Q\, h\, (T° - t°) \frac{459 + T°}{459 + t°}$$

If, for example, the chimney be 50 feet high, the temperature inside it 300° Fahr., while the outside temperature is 60° Fahr., the power usefully employed in making 10 cubic feet per second of fresh air enter the room would be only about five-hundredths of a horse-power. But merely to heat this 10 cubic feet of cold air, introduced into the chimney per second, requires about 46 units of heat, which is equivalent to 65 horse power. Hence to obtain a useful ventilating effect of only five-hundredths of a horse-power we expend as much as 65 or 1,200 *times as much as is necessary.* Now the efficiency of a fan is about $\frac{1}{3}$ or $\frac{1}{4}$, and that of a good steam engine $\frac{1}{9}$ or $\frac{1}{10}$, or of the two combined, say, as little as $\frac{1}{40}$, that is nevertheless 30 times as great as that of a chimney when used as a ventilator. But it may be said the fire is maintained not merely for ventilating purposes but for warming, or for domestic, or for some other purpose, and consequently the chimney draught must be produced whether we require it for ventilation or not. This argument is, however, quite fallacious since, in an open fire-place, very much more air goes up the chimney than is required for combustion, as is seen from the roar that takes place when a blower or a newspaper is held in front of the fire-place. Now, in a proper furnace we do not have a quantity of air drawn up the chimney which is not required for combustion, so that unless the amount of air to be withdrawn for ventilating purposes is not more than the amount of air required for combustion, and unless also this air is tolerably fresh and suitable for combustion, there must necessarily be an increased expenditure of fuel to cause a ventilation draught up the chimney, and as I have shown, this expenditure will be made in a most expensive way; and this reasoning is equally correct, whether the air that is drawn into the chimney for ventilating purposes be introduced at the bottom, and so warmed by the fire, or whether it be sucked up by a pipe entering the chimney at the top, similar to a jet pump. But it will be objected, how can we work a fan? In many buildings a steam engine is already working, and the extra cost of driving a few fans would be inconsiderable. In other cases, the use of hydraulic power is at first sight very tempting, since there is a supply of water in nearly every house; but a simple calculation will show that such a system would not be economical, since, while a gas engine can be worked at a penny per horse-power per hour and a steam engine at between a halfpenny and a farthing, a water-motor in London will cost over a shilling per horse-power per hour. If, however, the ventilating arrangement be only required in exceptional cases, as at the Institution of Civil Engineers, a small hydraulic engine driving a fan may be as economical as paying the weekly wages of a stoker, but not so economical as using a gas engine, which, unlike a steam engine, can be worked without having a special stoker. Water power is too expensive, even for public buildings, dining rooms, &c., where many people congregate, and separate steam engines are, of course, out of the question, for working fans for ventilation. What are we to fall back on then if we wish the ventilation to be independent of windows and fires? We must of course use

distributed power, and the one which is at our command is gas. Now, judging from the amount of success that has been attained with gas engines, of even so small as ½ and ¼ horse power, I do not see the impossibility of a small gas engine with a fan being employed, in every building of any size, to ventilate the rooms, summer and winter. Possibly in the future, when electricity is supplied like gas, these may be replaced by small electro motors, which experiment shows have an efficiency about eight times that of the best steam engine. Next as to warming, which, in Mr. Perry's and my mind, is quite a distinct thing from ventilation. In a room heated by an open fireplace, the air directly heated goes up the chimney, and since the greater the heat the greater the draught, we may say that all the heating of the room and its occupants is performed by radiation. The want of economy in this method of heating is more than overbalanced in most people's mind by the result. When stoves or hot air, hot water or steam pipes, are employed, the heat given to the room is partly by radiation and partly by convection, or the circulation through the room of air heated by actual contact with the hot pipes. This heating of the air appears to destroy its freshness, and whether this is due to the destruction of some chemical constituent like ozone, or of aromatic particles, such as come from living vegetation, or whether it is merely a drying of the air, or lastly, whether the practical unpleasantness arises from heating without proper ventilation, it is probably preferable to employ simply radiation, and to dispense altogether with the circulation of heated air through the room, if this can be easily and economically done. Now we think this may be effected in one or other of two ways: either the open fire-places may be retained in form but the small radiating surface of incandescent coal replaced by a larger radiating surface of pipes heated by water or steam supplied by a boiler in the building, or better still to a whole street or neighbourhood from a common centre; the chimney might remain to carry off the heated air and produce the ventilation of the room, or better, the ventilation might be performed quite separately and the chimneypiece furnished with a small ledge projecting donwards to prevent the air heated by direct contact with the hot pipes escaping into the room, so that the pipes should warm the room simply by radiation. Or the present form of fireplace might be abandoned and the pipes placed vertically in the room *reaching to the ceiling*, but not necessarily to the floor, in which case the heated air would cling to the pipes and not circulate, and this result might be attained with still greater certainty if the vertical pipes were furnished with several small ledges surrounding them, and sloping downwards so as to trap any ascending hot air. It might be objected that our heads will be chiefly warmed by this radiated heat and that would be unpleasant. But we must not jump to the conclusion that because the radiation of violet rays from the sun on our heads is unpleasant in summer that the radiation of dark heat, such as comes from a kettle of boiling water, or indeed, at present, from the walls of an ordinary room, would be necessarily unpleasant.* And if this be true there does not seem to be any serious objection to our radiating pipes being on the ceiling, when we shall be sure that all the heat we receive from this will be radiated and not convected. The other objection that might be made, namely, that we should suffer then still more from cold feet, is met when it is remembered that one of the chief causes of the draughts along our floors is the open fire-place, which is situated so near

* The recent experiments of Dr. Siemens, which show that, while the ultra-voilet rays of the electric light are highly injurious to vegetation, the less refrangible rays are highly beneficial, is a case in point.

the floor. In conclusion, let me add that I think a Paper like that of Mr. Robins, thought out carefully, illustrated by many practical examples, and written not to advocate some particular hobby or the patented methods of some special firm, but in the earnest desire merely to arrive at what is the best and the most right, must stand forth prominently in the battle of science against disease.

WILLIAM WHITE, F.S.A., *Fellow.*—There are one or two considerations which the last speakers have opened up, and which it would be well to take into account. One is the equable, or the unequable, temperature of the different strata of air in the room. I cannot quite agree with Professor Ayrton that it would be better to warm the ceiling of the room, because that would rather increase the difference of contrast between the temperature at the ceiling and at the floor, and I think there are already many people who suffer as well from hot heads as from cold feet. Some years ago I suffered seriously from the gaslights in my sitting room, and one evening, when the curtain was unhooked, on getting to the ceiling I was struck with the immense heat into which I was putting my head. On that account I do think these so-called Tobin pipes are of great value, because the natural course of the air is towards the ceiling, tending to make the warmth more equable; and I think the bad air may be carried off without objection by having the exit some feet below the ceiling, some six or seven feet from the floor. This could prevent the upper stratum mixing much with, or vitiating, the air below. It would assist in carrying off the unchanged air much better. As regards the warming of the house generally, I have found great comfort from having an air warmer in or under the hall; the room doors can then be kept constantly open, and fresh air being admitted into the hall will create a considerable change of air through the house if there is a proper exit also for the vitiated air above, as there was in my case.

Mr. C. SPENCER ROLFE.—I had desired to discuss somewhat at length many points connected with the drainage and drain ventilation of buildings, but since the hour is late and the discussion has been very long, I will confine myself in the few remarks I shall make solely to the warming and ventilation of rooms. All who desire to render a system of ventilation thoroughly efficient should be guided by two fundamental principles which are rarely considered. In living-rooms the air near the ceiling is hot, and vitiated in closed rooms with gas burning, so much so as to be intolerable, whilst below this, it is both cooler and less and less vitiated, until at the floor level we find the coolest and purest air in the room. Hence it follows: Firstly, that in all cases the inlet or inlets should be placed as near the floor as possible, and the outlets as high up as possible; and secondly, that it is necessary to increase the volume of inflow in direct proportion to the height at which it is permitted to enter. Unfortunately it has become the practice to employ a few large openings for this purpose, and to place them some distance up the side of the room, thus insuring the air being somewhat warmed before reaching the lower strata, but that any departure from the principle I have laid down is injurious can be easily demonstrated. Take for example a case where the inlets are near the ceiling, and the outlet is the chimney opening. The cool air entering, is by virtue of its velocity, spread over the ceiling, and, being of greater density than the heated air, commences to fall down. In its passage it meets with ascending currents, due to the expired air of the occupants being of somewhat high temperature, to lights and so forth, with which it gets warmed by admixture, and finally reaches the breathing level in a semi-vitiated condition. It will be

readily understood that under such conditions the air of a room can never be pure. I cannot too strongly impress upon you the fact that air being a non-conductor must be heated by direct radiation, and, failing this, by admixture with warmer air. In introducing air through a tube (say a so-called Tobin's tube) it is necessary to compromise the principle by forming the terminations at some height above the floor, in order that the air may get partially warmed before reaching the faces of the occupants, and otherwise causing a sensation of cold. Doubtless it will be thought that all I have now said points to the conclusion that we cannot hope for effective ventilation unless the incoming air is warmed, but whilst this is true for nearly all the plans usually followed, it is by no means universally applicable. It is only necessary that the openings shall be *small, numerous and correctly placed,* and a room may be thoroughly ventilated on a cold winter's night, without in any way inconveniencing the most sensitive occupant. In one or two cases in my own practice I have placed the skirting boards at a slight distance from the wall (specified at a quarter of an inch, but scarcely visible when the paper was put on) and frequent inlets for air were made behind them. Whilst the plan fulfilled its purpose admirably and without perceptible draught, it was, whilst suitable to the class of houses to which I applied it, open to great objections on account of their being no means of removing accumulations of dust, &c.; but I believe the same plan somewhat more elaborated will hereafter prove of considerable value. All who have had any experience in such matters will agree with me as to the importance, or rather the absolute necessity, of having some means of filtering the air, more especially in large towns such as London. A very good plan is to have a flap sufficiently large to cover the opening (which must be considerably larger than the inlet tube) formed of two thicknesses of wire gauze, or perforated zinc, between which should be placed some "silicate" (virtually glass) wool; it must be put in very carefully, because the slightest obstruction outside the ventilating opening would stop its action. This flap should be hung by hinges, so as to rest against the tube, which should be made of zinc, or wood varnished inside; when it is desired to clean it, it is only necessary to pass a bucket-full of water through it, the flap being raised by its passage, and at the same time thoroughly cleaned. The silicate wool will last an indefinite time, as it is indestructible under ordinary circumstances. I certainly cannot agree with Mr. Robins in his advocacy of Tobin's tubes, not only on account of the objections to them which I have previously mentioned, but also because I consider that any system of ventilation of rooms should not be too distinctly visible, and should be placed beyond the control of the occupants. Should there be any such control, or should the openings for the entering of the fresh air be prominently placed, sensitive people would be constantly imagining that they felt a draught. The tube would then be closed by the arrangement provided for the purpose, and the chances are that it would never again be opened. With regard to warming, despite what Professor Ayrton has said, I find it extremely difficult to dissociate warming from ventilation, our house ventilation being entirely dependent upon heat for the production of the necessary currents. I must also disagree with Professor Ayrton in his ideal sketch of a heated ceiling, such an arrangement would not only prove very injurious to the occupants, but would render the efficient heating of the room extremely difficult. One of the best and most feasible means of heating a house throughout, is by a system of hot water pipes, not arranged as in the ordinary manner to be heated by one furnace, but receiving an increment of heat from every fire in the house. By such an arrangement all, otherwise wasted, heat would be utilized and

ventilation promoted, since the major portion of the heat would be derived from the lower rooms, which would be more highly heated in consequence than the upper ones, thus promoting upward currents of air. It is becoming the custom to use, somewhat largely, open stoves provided with a heating chamber at the back, the incoming air being heated in it, and delivered through gratings in the front. It is a fact generally lost sight of that the major portion of the fresh air entering is directly drawn up the chimney unless care is taken that the chimney opening is sufficiently reduced. This remark of mine applies also to ordinary grates, and it is astonishing with what a small opening an ordinary fire can be maintained with a very great gain in its heating effects. Openings for the entrance of air, be it heated or cool, should be as far as possible from the chance of being carried directly up the chimney.

EDWARD C. ROBINS, F.S.A., *Fellow.*—My friend, Professor Corfield, who opened the discussion on the 29th November last, deserves our thanks for his testimony to the general willingness of architects to entertain sanitary questions and to render every assistance in their power to rectify old abuses; and I think I may truly say that architects as a body very highly estimate the labours of the medical profession in this field of which the Professor is an eminent example. But he thinks I claimed too high a place for architects when I said that the practice of specialists was in harmony with the previous practice of architects. All I meant to say was that architects had less to undo than was generally supposed; and that, with the growth of public opinion and professional experts, architects also grew, and were not behind the best of specialists whenever they gave their minds to it. The inlet and outlet ventilation for housedrains, the better aeration and means of inspection and gaseous disconnection of housedrains from the sewer by means of manholes, and other matters, are modern improvements; so also is the admirable system of automatic flushing by means of Field's syphon flushing tanks, which I have used with great success, and fearlessly recommend anywhere and everywhere. In the year 1852-3—now nearly thirty years ago—I myself carried out in St. Pancras the various suggestions made by Mr. Chadwick in the blue-books of the General Board of Health. And my practice then was to put the syphon trap in the last length of the housedrain next the entry into the sewer—on the principle that to keep the gases out of the housedrain was better than letting them into it, to be trapped within the house or in the area outside the same, as was then and still is the prevailing custom. Moreover, I supposed that, if a stoppage took place, it would be easy for the sewer men to cleanse the trap from the sewer itself; but the sudden fall of housepipes towards the sewer in the last few lengths was likely to keep the syphon clear. I agree with Professor Corfield as to the importance of trapping sinks with ∽ traps before passing outwards to discharge over the gulley grating. To avoid the freezing up of sink-outlets, through the dripping or leaking of taps, plugs may be used instead of gratings to the sink itself. I was glad to find that Mr. Robson, of the London School Board, author of a valuable work on schoolbuilding, was able to agree with me in most things. On the old system of supplying water-closets from service boxes in the cistern, the direct supply of drinking-water therefrom was highly objectionable, especially as the cistern was commonly placed in or over the highest water-closet, but waste preventors as now used overcome the first evil, and service boxes are quite discarded. However, just as the fear of bad workmanship makes it desirable to put soilpipes outside instead of inside the walls, so the chance of defective planning and

execution makes it not less desirable to have separate cisterns to supply water-closets only, and even where constant service exists, an intermediate cistern is desirable. The modern waste-preventor of the Water Companies provides such a separate service; and if these contain from two to three gallons of water for each discharge, I see no objection to waste-preventors, except you choose to employ some water-closet apparatus, which will not clean itself without such a scour as no waste-preventing system, short of the noisy "Shrewsbury," will provide. It is this that inclines me to favour trapless closets, in well ventilated drainage, the water seat being above the plug, which when raised hurries everything away without the intervention of an invisible trap, which checks the flow and is rarely quite cleared before the supply of water ceases. I was glad to hear Captain Galton's remarks on ground air, and Mr. Ewan Christian's on hollow walls, their advantages and disadvantages. I have elsewhere treated of both. Mr. Symons touched upon a wide subject, namely, the existence of inferior speculative building in the metropolis. Professor Lewis, in his memorandum opening the second discussion, proved too much for his argument, because, as Mr. Rogers Field showed, if his six points were accomplished facts, there would be no special ventilators required. If the storm waters were to be separated from the soil drainage, and a new system of soil drainage were to be constructed on the latest principles of sanitary science and economic construction, it would involve the immediate and complete removal of all organic matter as soon as it was formed; and sewers so constructed, properly flushed and ventilated, would be comparatively innoxious. Nevertheless, as the Professor wisely suggests, chemical means might be employed to neutralize or deodorize the contents of the sewers as a precautionary measure. The memorandum read by Mr. Redgrave, from General Scott, carries out Professor Lewis's idea. Colonel Malone, of Ryde, has sent me a description of his system of doing the same thing in a more complex manner, separately treating each housedrain with liquid precipitants. Mr. George Barnard, a retired Indian medical officer, has fitted up, at his house in Kensington, an apparatus by which the ordinary trapped water-closet may be connected with a removable receptacle for the solid matters, the liquid passing through the perforated bottom and dripping in to long boxes filled with earth, fixed under one another in zigzag form, five in number. The earth absorbs all the nutritious matters, and the clear water I hold in this bottle is all that comes from the last earth filter, which has no smell. The air from the upper part of the solid excreta receptacle is taken by a pipe into the bottom of a charcoal air filter, and the pipe that issues from the top brings no smell. The box of solid matter and the supersaturated earth are both valuable articles of agricultural use, and may be sold not only to pay expenses, but to pay a profit. No soildrains and no foul sewers would be required if it were practicable to carry out such a scheme as this, and he thinks it is. Mr. Rogers Field's remarks, as might be expected of him, were all to the point. He was one of the first, if not the first, to employ the new manhole disconnecting arrangement, and external well-ventilated soilpipes. His evidence on the subject of frost is valuable, but it was not given in sufficient detail to be of more than general service. Under all the circumstances, doubtless, it is best to have the soilpipes external to the building, provided always that the arms of overflows and wastes are protected from the effects of frost—the pipe being carefully set in cement, in the hole in the wall through which it passes. My experience has shown me that the most frequent defect is in the setting of the apparatus, and leakage is most common at the junction of the pan or syphon with the soilpipe

before it passes through the wall to the exterior. Mr. Rawlinson's vast experience and practical way of looking at everything give great value to all he says; and the new volume of the Sanitary Institute, detailing the doings and sayings at the Exeter Congress, is full of matter for serious reflection, to which he has contributed largely. I may say that I have used the earth-closet system with great success in country boarding-schools. Professor Kerr's suggestion as to a subway he will soon have the opportunity of seeing realized in the new premises approaching completion in Maddox Street, for Mr. Boyd. The iron housedrain and other pipes will pass through a subway, 6 feet 9 inches in height and 4 feet wide, situated below the basement. As he justly observes, the engineers are at fault in constructing sewers so as to be in many places elongated cesspools, or sewers of deposit instead of suspension only. It is all very well to complain of our laying on sewer gas to the houses, but it must not be forgotten that the production of such gases has no business to be. I have elsewhere answered some of the objections made by Mr. Dawson, and have only to repeat what I said in my second lecture at the Parkes Museum, with reference to the advantage of vertical shafts for the introduction of fresh air. The Opthalmic Ward at St. George's Hospital is perfectly ventilated by vertical wall shafts, as in this room, and there is no other extract shaft than the chimney of the fire, yet there is no perceptible draught in any part of the room. It is only fair to say this in justice to Mr. Tobin. Professor Ayrton's ingenious remarks were exceedingly suggestive, as showing how radiated heat may be obtained from hot-water or steam pipes without introducing the conducted heat; but I should hesitate to adopt it for ceilings, since the first object to be warmed by the radiation would be the heads of the people under it. I owe him and Professor Perry many thanks for the great interest they have shown in working out by calculation many interesting questions arising out of the discussion of my Paper. The useful remarks of Mr. Rolfe, Mr. Seddon and Mr. Hayward need no comment, and I am glad to find myself on the whole *en rapport* with my professional brethren, whose patient hearing demands my acknowledgment, and whose interesting discussion of the Paper has contributed in no small degree to its value. I have not very fully responded to some of the remarks made, because it is my intention to take advantage of the new system upon which the Papers of this Institute will be published, and to furnish careful Appendices. I have but one more remark to make and it is this. As a member of the Council of the Sanitary Protection Society, I know enough of the details of its working to be able to assure my friends that the work done by that Society is well done, and the co-operation of the philanthropic element, which quickens their action, is invaluable for the popularization of sound principles of sanitary reform. Those who are jealous of their interference have but a small conception of the vastness of the field which the metropolis alone provides for its exercise.

APPENDICES.

A, see page 64.—The following comparative analysis of the principal systems of Heating, namely, by Hot-Air, Steam and Hot-Water has been supplied to Mr. E. C. Robins by Mr. A. J. Bacon:—

Deperdition of Heat. Before describing individual systems of heating-apparatus, a glance may be taken at the basis of calculation on which such apparatus must be constructed. It may be premized that scientists, in order to define given quantities of heat, have assumed as their unit of measure the specific heat of water—

i.e., the amount of heat necessary to raise 1 lb. of water 1° Fahr. in temperature—and that they express all other quantities in terms of this measure. The specific heat varies with the class of material acted upon. Thus, the specific heat of air is 0·238 units, or about a quarter that of water. Another point that must be remarked, before entering further on this part of the subject, is the conducting power of heat that materials possess in various degrees, and which plays a considerable rôle in making such calculations. Thus, the heat, in terms of units, transmitted per hour for a difference of 1° Fahr. in temperature through a surface 1 in. in thickness is:—

For marble	28·0	For plaster	3·86
„ ordinary stone	13·68	„ oak—perpend to fibres . .	1·70
„ glass	6·6	„ fir	0·83
„ brickwork	4·83	„ paper	0·346

Hence it is evident that the amount of warmth lost by a room or building, heated above the external temperature, varies with the nature of the building material and the quantity used. By the aid of the above and other data, which it would take too long to explain, Mr. Box has constructed the following table, which may be useful :—

Loss per Hour for 1° difference of Temperature.

Brick Wall.		Stone Wall.	
Thick.	Units.	Thick.	Units.
4½″	0·371	6″	0·453
9 ″	0·275	12″	0·379
14 ″	0·213	18″	0·324
18 ″	0·182	24″	0·284
27 ″	0·136	30″	0·257
36 ″	0·108	36″	0·228

The co-efficient for ordinary window-glass is 0·53, and for double glass 0·27 units.

An examination of the above tables will at once show that an architect, by careful choice of his building materials, can himself do much towards economizing the expense of heating hereafter—it being patent that the use of good brickwork in place of stone, of double windows instead of single, of thick or hollow walls instead of thin or solid, is always of ulterior advantage and economy. The above tables will serve to determine roughly the amount of heat lost per hour under fixed conditions of temperature, though in practice several other factors, such as height, aspect and number of external faces, would have to be taken into consideration. The probable frequency of use would also require to be taken into account : thus it is evident that where a building is used only occasionally—a church, for example—it is useless putting in a heating-apparatus only sufficiently powerful to make good the hourly deperdition of heat, whereas, in turn, this might be amply sufficient in the case of a hospital or similar building, where the fire is constantly kept going.

Having determined the amount of heat necessary for the loss per the walls, &c., that required for the air introduced for ventilation must be ascertained. This can be done roughly by the aid of the formula :—

$$(1) \quad 0{\cdot}01817\, n\, (T - t)$$

Where n = ventilation in cubic feet per hour
„ T = internal temperature
„ t = external temperature
„ $0{\cdot}01817$ = specific heat of a cubic foot of air at 32°.

This formula, however, does not give exact results, because the specific heat of air when considered in volume varies with the temperature as its density. It is therefore usual in practice to reduce volumes of air to weight in pounds, when the specific heat is practically constant at 0·238 units. The total thus obtained, added to that previously calculated for the deperdition, is the amount of heat the heating surfaces must yield per hour, and their surface can then be readily deduced.

Artificial Heating-Apparatus can be divided into five chief classes—viz., radiating fires, hot-air stoves, steam, hot-water large-pipe, and hot-water small-pipe apparatus. The first of these has already been considered by Mr. Robins.

Hot-Air Apparatus.—These are innumerable in shape and arrangement, some of good, some of bad construction. Their chief advantage is that great quantities of air can be produced at high temperatures, with a minimum of space occupied. They are, however of practically little service where ventilation is desired, inasmuch as they deteriorate the air they introduce, by over-heating and tainting. They are, however, very economical in first cost, when not coupled with an extended system of brick flues, but should not be introduced into buildings with roofs of different pitch, such as Gothic churches, &c., because the air will not properly circulate, and the effect is unequal. They should always be constructed so as to draw their supply of fresh air direct from the outer atmosphere, and not, as they frequently do, from the building itself. Great care should be used not to let the flues be in contact with any woodwork, as they are then highly dangerous. At Christ Church, Battersea, when such an apparatus was taken out, by the advice of the architect, Mr. Robins, the floor of the vestry under which the stove stood was found to be charred on the under side, to a depth of half an inch. On the Continent these apparatus are daily growing in disfavour, new constructions being, for hygienic reasons, generally provided with some system of heating employing surfaces at lower temperature. The heat given off per square foot of hot-air-stove surface varies from 1500 to 4000 units per hour.

To calculate the surface of such an apparatus the temperature of the air at its outlet must be determined (not higher than 100° Fahr.), and, the deperdition per hour being previously ascertained by calculation, the internal and external temperature fixed, the amount of air necessary for introduction must be evolved by the formula :—

$$(2) \qquad n = \frac{d}{0{\cdot}01817\,(T - t^1)}$$

Then, assuming 1 □ ft. of heating surface = 2750 units, the necessary surface will be :—

$$(3) \qquad S = \frac{{\cdot}01817\,n\,(T - t)}{2750}$$

In cases where the supply of fresh air is drawn from the building itself less surface is necessary, and the formula becomes :—

$$(4) \qquad S = \frac{d}{2750}$$

The consumption of fuel in such apparatus varies so much with their construction, that it is impossible to give any reliable data, though it may be taken :—

$$(5) \quad \text{At } w = \frac{{\cdot}01817\,n\,(T - t)}{5000} \text{ in the one case ; or} \qquad (6) \quad \text{At } w = \frac{d}{5000} \text{ in the other.}$$

d = deperdition in units per hour
n = quantity of air in cubic feet
T = temperature of air on entering room
t^1 = temperature of room
t = temperature of external air
w = weight of gas coke in lbs. per hour.

Steam-Heating is specially useful where the distances at which the heat is required from the boiler are very great, the velocity of the heating agent being far superior to any other that can be employed. It is, however, very expensive in combustion of fuel, inasmuch as it passes the water into the return pipe as useless just where a hot-water apparatus commences to flow—viz., at 212°. Roughly speaking, water rises in temperature at the rate of 1 unit per pound and per degree Fahr., until it reaches a temperature of 212°, when it boils. It then takes up 966 units of heat in a latent state in the act of vaporization, or of becoming steam. If, under pressure, the temperature at which ebullition commences rises ; but the amount of heat necessary to produce steam at any pressure remains practically the same. The calorific value of a pound of steam is nearly the same—viz., 966 units (the latent heat of vaporization), whatever the pressure of the steam employed. The only advantage, therefore, derived from high-pressure steam apparatus is a slight difference in the first cost, on account of a higher mean temperature of the heating surfaces; this advantage is, however, more than counterbalanced by the increased risk of leaky joints and defective tubes. It is usual, therefore, to employ steam at low pressure—say, at 1 atmosphere for the purposes of such apparatus.

Given the quantity of heat necessary for warming and ventilation, and allowing 10 per cent. for loss of heat in mains, the amount of steam required would be :—

$$(7) \qquad S = \frac{d \times 1{\cdot}1}{966}$$

S = quantity of steam in pounds per hour
d = heat required for warming and ventilation.

Supposing the feed water to enter the boiler at 60°, the quantity of heat necessary for producing this steam would be :— (8) $966 + (212° - 60°)\, S = 1118\, S$,

and the fuel necessary :— (9) $w = \frac{1118\, S}{7500} =$ weight in pounds of gas coal per hour.

Messrs. Geneste, Herscher & Co., of Paris, have erected steam-heating apparatus, where the main pipes have led away from the boilers, a distance of 1000 mètres, or 3280 ft., with perfect effect; and in America district steam apparatus have been constructed, distributing steam for varying purposes at distances over a mile from the boiler.

On the Continent, steam-heating apparatus have been brought to a high state of perfection—tubular boilers built on the Belleville principle are employed for the steam generation; the mains are laid in channels under the roof, covered with non-conducting substance, and branch from thence to the several heating surfaces placed in the rooms below. Each branch is fitted with a pressure-reducing apparatus, and each heating surface is connected with the condensed-water mains fixed in the basement, which lead back to the boiler. Every such connection is fitted with an automatic steam trap, which opens whenever the water accumulates, and allows the same to pass, closing, however, at once on the arrival of non-condensed steam and thus economizing the amount of steam used.

The heating surfaces employed are various, consisting of double-jacketed cylinders, vertical-ribbed tubes, or cast boxes. Messrs. Gebrüder, Sülzer, of Winterthür, who have perhaps the greatest name on the Continent for steam apparatus, employ double-jacketed cylinders chiefly, of which the internal hollow space is filled with tubes of small diameter. Messrs. D'Hamelincourt, of Paris, again, employ cast tubes fitted with ribs ranged either longitudinally on the outside of the pipe or transversely, according to circumstances. In Germany, boxes having a surface varying between 2, 3, and 4 □ mètres are employed. The boxes are made with vertical cast ribs, and are used singly or connected together in series, according to the surface required, with flanged joints and asbestos packing. The calorific value of these various forms of surface is 390 units per □ ft. per hour for plain, and 260 units per □ ft. per hour for ribbed, surfaces.

Such apparatus should, however, only be put up by capable persons, and left in the charge of responsible hands. At St. John's Cathedral (Catholic), Salford, a steam apparatus was taken out some years ago of which the boiler was of single-flued Cornish pattern. The steam pipes, 4 in number, leading from same passed down the whole length of the nave, and terminated with $1\frac{1}{4}''$ tubes fitted with a cock (!) for regulating the escape. Fortunately for the congregation, these cocks had never been used, since, when taken out, the boiler was found to have its safety-valve jammed down by means of a block of wood (! !) inserted between it and the arch over.

Large-pipe Hot-water Apparatus.—This, the most common form of heating apparatus in England, is perhaps also the best understood in the country; but, being often put up by persons utterly ignorant of its principles of action, the effect produced is not always satisfactory. This system has the great advantage over all its competitors of retaining its heat for a longer period after the fire is extinct, though of course it also possesses the corresponding disadvantage of requiring the most fuel to attain its effective heating temperature. Properly constructed, it is simple and certain in action, and, if its joints are made on a good principle, should last a long time. The tubes consist generally of cast-iron, fitted with either flange or spigot and socket joints, caulked with red and white lead and yarn. Lately, however, several forms of joints have been introduced, based on the employment of india-rubber rings or slips—such joints being now used generally by Messrs. Haden and Sons, of Trowbridge, and others. The boilers used for this apparatus are legion in pattern, the most common form being that known as the saddle-backed boiler. Tubular and Cornish boilers are used for larger apparatus. Messrs. Hartley and Sugden of Halifax, construct a series of very ingeniously designed boilers for this system of apparatus, made of welded plate iron. Taking the temperature of the pipes on leaving the boiler at 212°, and at the return at 100°, the surfaces would have a calorific value of about 160 units per □ ft. per hour. On account, however, of the large body of water and weight of material in such an apparatus—which has to be raised to the mean heat before it begins to yield its full effect—it is very extravagant of fuel. Thus, taking the mean heat as above at 156°, and the temperature of the apparatus before lighting the fire at 40°, the materials have to be raised 116°, and the amount of heat necessary for the several sizes of tube would be per foot run :—

For 2-inch pipe = 288·4 units
„ 3-inch pipe = 539·4 „
„ 4-inch pipe = 868·8 „

Given the amount of pipe, it is easy with the above data to ascertain the amount of fuel necessary for raising the apparatus to its effective point, the formula being for :—

$$(10)\quad 2''\text{pipe} = \frac{l \times 288{\cdot}4}{6500} = \text{weight in pounds of coke.}$$

l being the length of pipe in feet, and so on.

When once hot, the fuel used would only be :—

$$(11)\qquad \frac{d}{6500} = w = \text{per hour} ;$$

but, in order to secure such economy, a good stoker is required, since necessarily the grate service of the boiler is calculated for the larger quantity of fuel, and it stands to reason, therefore, that it is seldom attained.

Small-pipe Hot-water Apparatus.—This system, first introduced about fifty years since by Mr. A. M. Perkins, is based on a different principle to the foregoing—namely, on the fact that by the introduction of pressure the phenomena of ebullition are avoided, and water will rise beyond 212° at the rate of 1° per lb. per unit of heat, and that, in consequence, a far smaller diameter of tube can be employed. Allowing for the necessary expansion, owing to increase of heat—but not sufficient to permit of the accumulation of steam—and using a strong wrought-iron pipe, he produced a very useful apparatus, and one that might successfully have beaten all its competitors from the field, had not the principle been carried too far, and the use of too highly heating surfaces produced many of the evil effects for which the hot-air system is so justly disparaged. Conviction has, however, since introduced many improvements in this apparatus, and it can now fairly compete with its fellows. The old form of apparatus was constructed of tubes having an internal diameter of $\frac{5}{8}$ in., which, owing to the friction offered to the circulating water, rendered it impossible to attain an effective heat on the return pipe without the employment of excessive temperatures on the flow. Mr. Bacon, however, in conjunction with Mr. L. Perkins, introduced a larger section of tube—$\frac{7}{8}$ in. diameter—in the year 1864. This improvement rendered it possible to attain a greater equality of temperature at the two extremities of the circulation, and hence obtain the same mean result as formerly without the necessity of excessive heat in any part. This improvement was first introduced in Hamburg, and gave the system a wide extension in Germany, where it is universally esteemed, and thousands of apparatus have since been erected ; it has also revived its adoption in England of late years.

Besides the above, Mr. Bacon has further improved the system in several details, fixing the pressure of working by the use of valves instead of the above-mentioned expansion tubes, carefully regulating the fire-grate and furnace heating surface to the power of the apparatus, and introducing numerous minor improvements.

In 1878, Mr. Stainton introduced another important improvement in the shape of an alkaline solution for charging the apparatus. This overcame the necessity for keeping the fire going in frosty weather (even when not required for heating purposes), as was formerly the case, and thus improved, the apparatus may be universally adopted without fear of any evil result.

This system offers considerable advantages, viz., the rapidity with which the apparatus may be raised to its effective heat, and the small quantity of fuel necessary for doing so ; the ease with which it may be adapted to old or new buildings ; the simplicity of its management and its freedom from liability for repair. In place of a boiler its furnace contains a coil of precisely the same kind of tube as used for the *heating* surfaces, and since the temperature of this coil is ever increasing throughout its length, from the return to the flow, it is evident that, in a carefully constructed furnace, nearly the whole heat given off by the fuel may be passed into the apparatus. As a matter of fact the heat utilized in these furnaces is greater than that in any other form of boiler, being 90 per cent. of the actual total value of the fuel. The amount of heat required to raise one foot of this pipe to its effective heat is 112·48 units, which, as compared to that required in the case of large-pipe hot-water apparatus for equivalent surfaces, stands in the favourable proportion of 1 : 3·18, while the calorific value of equivalent surfaces of this tube and hot-water tube show the proportions of 1 : 0·6. The apparatus is therefore eminently economical as regards its extension of surface and the fuel it consumes.

Ventilation.—This is a subject in which England stands far behind its sister countries. Architects very frequently neglect the subject entirely, or introduce untried and often impracticable means, with less regard to the result required than to what the design of their building permits. This arises chiefly from their considering the matter only when the construction is so far advanced as to permit of no properly matured scheme ; and from their regarding the ventilation as a suitable portion of their programme upon which to exercise the pruning knife. But since there are no governmental precepts laid down, and the public are not exacting, this oversight is not astonishing.

On the Continent, however, this matter is considered of the very first importance, being usually decided before the commencement of a building, and entered upon at great cost. Nor do architects overlook the

importance, even if their clients would do so; for instance, Mr. Baeckelmans of Antwerp actually refused to carry out the erection of the town hospital—a building of considerable importance, and for the design of which he had obtained first premium in competition—because the Hospital Commission would not appoint an engineer to consider the plans with him, with regard to the heating and ventilation, before the foundations were laid.

The first point to determine, before planning a scheme of ventilation, is the amount of fresh air it is necessary to introduce for the purpose, and to assist in this it may be useful to quote various authorities.

Thus Ferrini gives a table which may be of service. Morin gives another in his volume on ventilation; and Wazon, in his "*Rapports sur l'Exposition de* 1878," part VI., p. 209, after quoting the preceding table gives a third—based on his own calculations. The three placed together and converted into cubic feet read thus :—

Species of Building.	Cubic Foot per person per hour. FERRINI.	Cubic Foot per person per hour. MORIN.	Cubic Foot per person per hour. WAZON.	
HOSPITALS :—				
General Wards	2450	2100	2100	3970 (Chaumont)
Operation Rooms	2700—3500	—	—	—
Infectious Wards	5250	—	—	—
PRISONS—By day	1750	—	1400	—
„ By night	—	—	1050	—
BARRACKS	1400—1750	1400	1050	2970 (Chaumont)
Stables	6300—7000	—	—	—
Ordinary Workshops	2100	—	—	—
Unhealthy do.	3500	2800	2800	—
Concert Rooms—Theatres . . .	1400—1750	1400	1400	—
Assembly Rooms	2100	—	—	—
Schools	525—700	420—525	700—1050	—
„ for adults	1050—1225	875—1050	1400	—
„ night	1225—1400	—	—	—
Ordinary Dwelling-houses . . .	525—700	—	1400	—
Offices	—	—	—	—

Dr. De Chaumont proposes for ordinary hospitals and barracks a ventilation of $85m^3$ or 2975 cubic feet per head per hour, and proposes further that this quantity, which is deduced from chemical experiments, should in the case of hospitals be increased one-third in order to insure a good result. This is quoted by Ferrini in his work, who, however, at the same time, remarks that the figures are excessive and at variance with other results obtained by the same author.

That the quantity of air necessary for ventilation is daily acknowledged to be far greater than was originally supposed is evidenced by the advancing opinions of all authors. Thus Péclet in his second edition of "*Traité de la Chaleur*," fixed $6m^3$ or about 210 cubic feet per person per hour as the maximum necessary for respiration; however, in his third edition he raised this figure to between 245 and 385 cubic feet, while later on, in the same volume, he advises 2100 cubic feet for the ventilation of hospitals; and in his last edition speaks of 3500 cubic feet as necessary for ordinary wards, 7000 for infectious, and 10,500 for lying-in wards.

Authorities being so various it may be as well to give some idea of what is demanded in practice. In Belgium, for example, the Government requires for all schools a ventilation equal to 700 cubic feet, and for barracks 40^{cm} or 1400 cubic feet per head per hour.* For the hospital at Antwerp, 2800 cubic feet per patient

* Since this was written, the amount of fresh air required for schools, by regulation, has been increased to 875 cubic feet per person per hour.

per hour, with power to increase to 5250 cubic feet, was demanded in the instructions to competitors for the warming and ventilating apparatus. In the Trocadéro at Paris 1400 cubic feet per person per hour are introduced; the fresh air enters at the ceiling and passes out through 5000 openings in the floor. This work was executed by Messrs. Geneste, Herscher & Co. of Paris, and is very satisfactory. At the Opera House in Vienna, ventilated on Bohm's system, $9000m^3$ are driven in per hour by means of a fan=to 1050 cubic feet per person per hour; the fresh air is introduced at every level and every point throughout the building, and passed off by the ceiling—the system being a perfect success. In designing a system of ventilation it is necessary, after determining the quantity of air required, to fix the principle on which it is to be introduced and warmed. Of these there are several:—

a, Ventilation by warm air drawn or driven from a common hot chamber.
b, id. id. id. from separate hot chambers.
c, id. by cold air passed over hot surfaces in the rooms themselves.

In the case (*a*) it is impossible previously to fix the quantity of air if the temperature is determined, because, as the air is heated to a common temperature, a sufficient quantity must be admitted, so that escaping by the exit openings, at the normal temperature of the room, it leaves in its passage the amount of heat necessary to make up for the deperdition per the walls, &c.

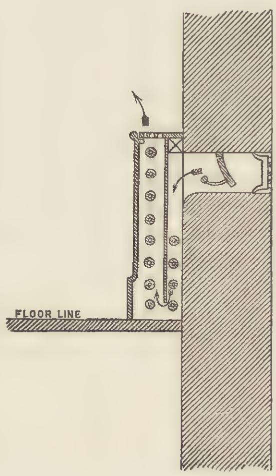
To calculate such an apparatus, therefore, the quantities of warm air necessary must be determined by the formulas used in the case of hot-air apparatus, and when thus fixed, the amount of heating surface must be determined according to the calorific value of the special kind of apparatus employed.

If, however, as in the cases (*b* and *c*), the heating surfaces necessary for each part are separate, the quantity of fresh air may be determined as well as the temperature of the room. Sufficient heating surface is placed in the hot chambers so as to deliver the air at such a higher temperature, that after replacing the deperdition per the walls it passes off, at the normal temperature, by the exit opening.

In this manner the great hall of Mr. Robins's Sandall Road Schools is heated. The heating surfaces are placed in vertical shafts in shape of 6 coils, each containing 100 feet run of small hot-water tube, the shafts are 14 in. by 18 in., and the height from floor of chamber to exit opening is 14 feet. The fresh air for these hot chambers is led along horizontal channels under the basement floor, being temperated slightly in its passage by the connection tubes leading to the coils. When at work the hall attains a temperature of 55° easily, with a freezing temperature outside, and a ventilation equal to 106,776 cubic feet or 356 cubic feet per person per hour. Under a difference of 55°—30° the deperdition of this hall is about 31,694 units per hour; the velocity in the shafts varies from 2·5 to 4·7 feet per second, with a mean for the six shafts of 3·3 feet, and the total amount of heat passed up in this air is equal to 60,000 units per hour. The total amount of heat added by the audience=to 300 persons is 300 × 191=57,300 units; the total amount of heat in the air is therefore 57,300 +60,000=117,300 units. The hall can therefore be maintained at a temperature of 55° even with an external cold of:—

$$55^\circ - \frac{117300}{\frac{31694}{25} + (106776 \times {\cdot}01817)} = 55^\circ - 36.6^\circ = 18.4^\circ$$

The system *c*, namely, that of heating surfaces placed in chambers or boxes in the rooms themselves, has been introduced by Messrs. Bacon in several school buildings on the Continent. The heating surfaces, calculated according to the deperdition of the heat required, and the heat required for the air admitted for ventilation ($20^{m\,3}$ per person), are fixed in a cast-iron box, ranged dado fashion along the outer wall, with a grating above to permit the passage of the warmed air. This box is placed in communication with the outer air by means of openings contrived under the windows, fitted with automatic regulating valves which close with any gust of wind, thus:—



The air entering at the base of this hot box passes through the same and out by the grating—the difference of temperature attained in the classes being 40° Fahr. despite constant ventilation. Such an apparatus has been erected by them at the Athénée at Tournai, with such satisfactory results that they have since been instructed by the same municipality to heat the theatre and a large girls' school, and have through its recommendation obtained the contract for warming a large school of 35 classes in Brussels and another at Couvin.

The action of the various apparatus above described is based on the principle of the air passing up the shafts through its own lightness of weight—the rules for calculating the velocity, where not known, or if known, the temperature in the shaft necessary to attain such velocity, being, according to Wolpert's formulas, (as corrected for English units of measure):—

$$(12) \qquad v=\sqrt{\frac{2gh(T-t)}{459+t}}$$

$$(13) \quad T=t+\frac{v^2(459+t)}{2gh}$$

Where v = Velocity in feet per second
„ h = height of shaft in feet
„ t = temperature of room
„ T = „ of shaft.

In certain cases, however, it is convenient to substitute mechanical means in order to attain the velocity: for instance, where the ventilation is required both winter and summer, and no difference in temperature can consequently be relied on to actuate the current, or where the amount of air admitted cannot be allowed to fluctuate with the external temperature, or where the quantities of fresh air required are greater than can be conveniently attained at low velocities. In such cases a fan driven by steam or water or wind power is employed.

Messrs. Verity & Sons have lately brought out a fan of this description, driven by a fine jet of water, which is very useful for small purposes, but the expense of working it prevents its adoption in buildings of importance. In such cases a large fan, driven a slow rate, is more expedient; and where the use of a steam engine is objected to a gas engine on the "Otto" principle may be advantageously employed.

Extract Ventilation.—No system of ventilation is complete unless the extraction of the air is provided for, as well as the inlet, and in equal volumes. To carry off the foul air, shafts should be constructed in the walls, working naturally in the case of inlet ventilation by means of a fan, and artificially where the inlet is provided for by natural means. The best system of extraction in the latter case is a draught chimney heated by the smoke from the boiler or furnace. The volume of air passing through the shaft being known, the temperature can readily be determined by the formula:—

$$(14) \qquad T=t+\frac{1.44\,s\,(t^1-T)}{2\times 0{\cdot}238\,w}$$

Where s = surface of flue—and
„ w = the quantity of air to pass over same in lbs. weight per hour
„ t^1 = mean temperature of flue.

T being thus ascertained it can at once be inserted in formula (12), the velocity found and the area fixed.

The section of the downcast shafts, leading from the several rooms, should be sufficiently ample to allow of a velocity not exceeding 3 feet per second, and the area of channels connecting these with the upcast shaft can be roughly determined by taking the mean of the velocities of the downcast and upcast shafts together, or $\frac{v+3}{2}$. Care should be taken that these channels flow as directly as possible to the main upcast shaft, and that corners are avoided. The higher the shaft the greater the velocity, and the less heat necessary for the draught. In place of the smoke flue, heating surfaces of the same nature as the apparatus, gasburners, or draught furnaces may be employed, the same formulas serving in all cases.

In buildings used for public assemblies, such as theatres and concert rooms, the question of ventilation is abnormal—such buildings requiring absolutely no artificial warmth since the audiences suffice to heat them to suffocation. It is, however, impossible in winter to cool them down without inconvenience by the introduction of fresh air at the external temperature, and the air admitted must therefore be temperated first, and introduced at some point below the normal temperature, say 15°. The volume necessary for ventilation then becomes:—

$$(15) \qquad v = \frac{191a-d}{.01817\,(T-t)}$$

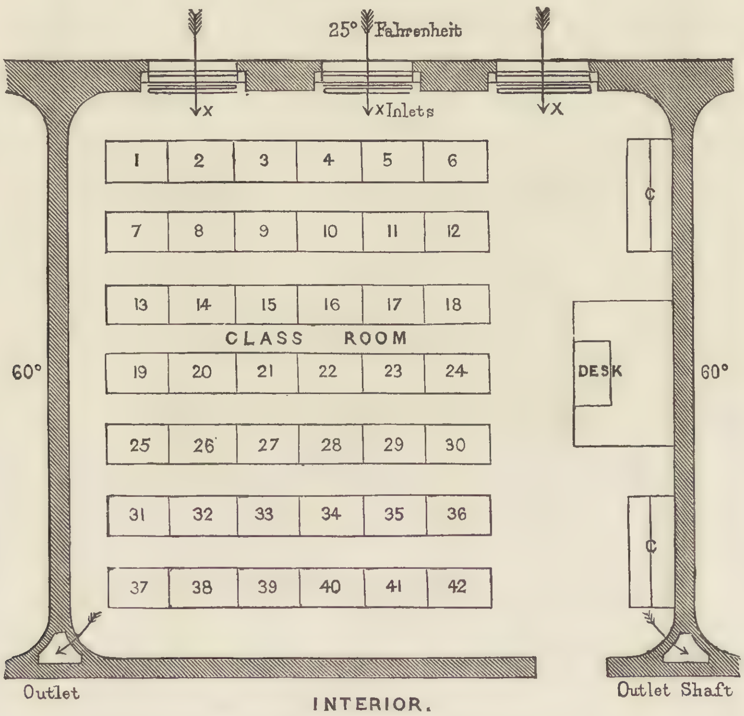
In which a = number of persons in audience
„ d = deperdition at fixed difference of temperature per hour
„ T = temperature of air at entry
„ t = normal temperature of building
„ v = volume of fresh air in cubic feet per hour.

B, see page 64.—The following demonstration has been supplied to Mr. E. C. Robins by Mr. A. J. Bacon:—

PROPOSITION made to Mr. A. J. Bacon by the author of this Paper. A class-room for 40 (the diagram shows benches for 42) pupils in a secondary school or college, wherein 15 square feet of area are allowed for each pupil, requiring a room measuring 25 × 24 feet. The height of the room to be a clear 13 feet—the angles of the room being rounded at a radius of 2 feet; 60° Fahr. to be maintained per hour as a constant temperature concurrently with a change of air at the rate of 700 cubic feet per head; the windows to be on one side and on the left of the pupils, and to measure 9 feet high by 4 feet wide; the door to be in the opposite wall, lef of the teacher. There would be accommodation, in desks opposite the teacher, for seven desks in a row, six rows deep with interspaces.

PLAN.

EXTERIOR.



INTERIOR.

CORRIDOR.

The class-room is presumed to be one of a series arranged on either side of a central corridor 10 feet wide two storeys in height, with a low basement under.

The minimum thickness of wall is imagined, namely, 14-inch outer walls and 9-inch internal walls.

The class-rooms on each side of it and the room over it, as well as the room itself, are supposed to be heated to a temperature of 60°, while the outside temperature is 25°, and the corridor 50°.

The artificial system of heating may be by hot-water, either high or low pressure, or steam apparatus.

The inlets for fresh air are to be at the lower part of the centre of the window-backs, and the air to pass through the hot-water or steam coil or box occupying the whole of the window-back, the openings from which to be at the top of the case. (*See* page 115.)

The outlets are to be opposite the windows, in the spandrils of the corners, and in the winter to open at the bottom of the room, and in the summer at the top, and are to be under control.

ANSWER. The method of calculating the losses of heat, the areas of the inlet and outlet shafts, the consumption of fuel, &c., would be as follows:—

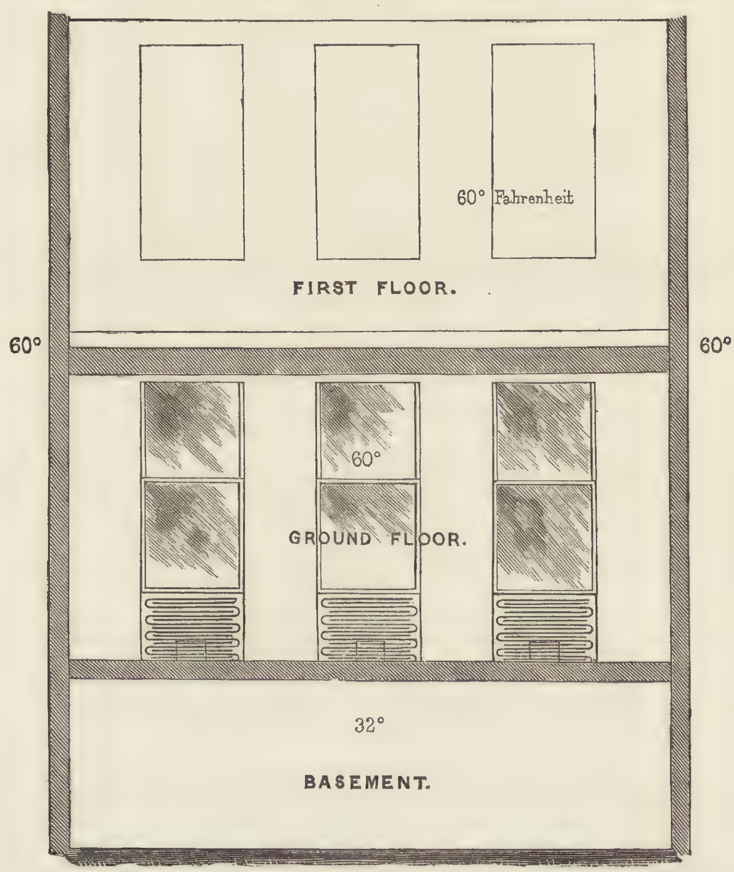
The amount of heat required to keep the class-room at its normal temperature would be the sum of the

Q

quantities $d + a - c$: where $d =$ heat lost by radiation and conduction of the outer surfaces, $a =$ heat necessary to warm the incoming air, and $c =$ heat given off by the children. For convenience of calculation these various quantities are usually calculated for the fixed period of one hour.

SECTION.

THRO' GLASS ROOM.



Heat lost per the walls, &c. The amount of heat lost by any surface varies with its nature and thickness; but the calculations necessary to determine such losses are very involved, and too abstruse to be entered into here. We can, therefore, only state the coefficients necessary for determining the loss in the supposed instance, which are per degree Fahr. difference of temperature. (See *Practical Treatise on Heat*, by Thos. Box, London, 1880):—

9-inch wall (brick)	0·275 units per □ foot.
14-inch ditto	0.213 „
Glass	0·53 „
Floor	0·164 „

Applying these to our case, we arrive at the following results:—

14-inch outer wall . .	$\left[\{(25 \times 13) - (3 \times 9 \times 4)\}(60 - 25)\, 0{\cdot}213\right]$	= 1617 units.
Windows	$(9 \times 4 \times 3)(60 - 25)\, 0{\cdot}53$	= 2003 „
9-inch wall towards corridor	$\left[\{(25 \times 13) - (8 \times 3{\cdot}5)\}(60 - 50)\, 0{\cdot}275\right]$	= 816 „
Door in same . . .	$(8 \times 3{\cdot}5)(60 - 50)\, 0{\cdot}53$	= 148 „
Floor	$(25 \times 24)(60 - 32)\, 0{\cdot}164$	= 2755 „

7339 units $= d$.

Heat necessary for ventilation. The quantity of fresh air necessary being 700 cubic feet per head per hour, and the number of children in the class—40, it is evident that, allowing for one teacher, $700 \times (40 + 1) =$ 28,700 cubic feet must be admitted. Since the volume of air varies directly with the temperature and the "specific heat" inversely, it is usual to reduce quantities of air to weight in lbs., in order to be able to neglect these variations. Thus, supposing that the fresh air is taken from outside at 25°, its volume at that temperature, calculated by Regnault's rule,

$$V^1 = V\frac{458{\cdot}4 + t^1}{458{\cdot}4 + t} \quad \begin{matrix}.25\\60\end{matrix}$$

would be 26,761 cubic feet only, but the weight would remain the same :—

$$\frac{28700}{13{\cdot}1} = 2191 \text{ lbs.}$$

and 0·238 units being the specific heat of air, the heat necessary to raise this weight of air to 60° would be

$$2191 \times 0{\cdot}238\ (60 - 25) = 18242 \text{ units} = a$$

Heat given off by the children. According to M. Dumas, the quantity of carbon given out by an ordinary person is ·022 lb. per hour, and the heat thus developed is $12906 \times {\cdot}022 = 284$ units per hour. A considerable part of this heat, however, is absorbed by the vapour formed during respiration, and becomes latent, the amount from 62° being $\cdot 0836 \times (1178 - 62) = 93$ units. The remainder, therefore, available for heating purposes is $284 - 93 = 191$ units. In our case, therefore, we have :—

$$41 \times 191 = 7831 = c.$$

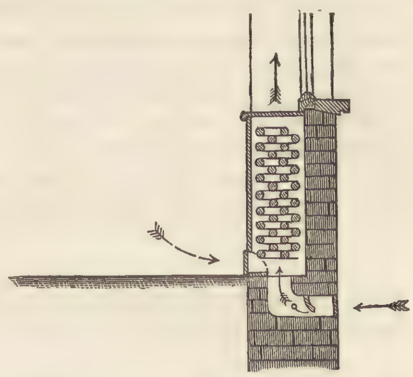
Setting the various values obtained, according to our formula $u = (d + a) - c$, we find :—

$$u = 7339 + 18242 - 7831 = 17750 \text{ units.}$$

The above equation shows—that while the walls lose a certain proportion of heat, this is more than supplied by the children themselves ; and that after the normal temperature has been attained, the apparatus serves really to cool the room down, instead of heating it, inasmuch as the air entering would only be heated to :—

$$25 + \frac{17750}{2191 \times 0{\cdot}238} = 59°$$

The best manner of arranging the heating surfaces would be in stacks, underneath the windows and recessed in the walls, connected directly with the outer air by means of an opening under them, opened and closed alternately, with a similar opening from the room at their base, thus (see woodcut) :—



The coverings for these coil recesses should be of cast-iron, in order to benefit as much as possible from the radiant heat.

When heating the room, the opening under the coil would be closed, and that in the front and at the base of the coil-box opened—so that the temperature may be the more quickly raised, inasmuch as the internal, instead of the external, air is circulated through the hot box. When, however, the class commences, and ventilation is required, this principle is reversed, and the cold air enters the box. The air thus heated may be allowed to pass through gratings in the window-sill directly into the class-room, or, if preferred, up shafts constructed in the piers between the windows, and into the room through openings near the ceiling. In our case, where the air would not enter at a high temperature, the former arrangement is preferable, because there is no difference of temperature between the inlet shafts and the room itself to actuate the current, and the latter would therefore be induced solely by the extract apparatus—and since this would exert an equally powerful influence on the window cracks as on the shafts the result might be very doubtful.

A further advantage of the former arrangement is that the currents of hot air, passing in front of the windows, tend to neutralize their cold radiation.

As already stated, the motive power of such an apparatus is the extract shaft. This can either lead directly up through the roof to the open air, or be taken down to the basement, and there connected with a common upcast shaft.

Granted that we ventilate our class-room by shafts leading directly up from the floor level to the outer air. Having a floor above of similar height and the pitch of the roof above that, we may assume 40 feet as the height

of our shaft. The temperature in the same would naturally be that of the room, 60°, and for the outer air we can take the mean temperature—say, 50·4°. Calculating by Wölpert's formula :—

$$v = \sqrt{\frac{2\,g\,h\,(T - t)}{459 + t}}$$

v being velocity in feet per second, h being height in feet, T temperature of shaft, t that of external air, our case would give :—

$$v = \sqrt{\frac{64{\cdot}35 \times 40\,(60 - 50{\cdot}4)}{459 + 50{\cdot}4}} = 6{\cdot}96 \text{ ft. per second, as the theoretical velocity.}$$

According to Péclet (see *Traité de la Chaleur*, by E. Péclet, Paris, 1878), however, 60 per cent of this is lost in practice through friction, and we must therefore only calculate on a velocity of $6{\cdot}96 \times 0{\cdot}4 = 2{\cdot}78$ ft. per second. The velocity being thus determined, the area required for the extract shafts is readily fixed, namely :—

$$\frac{28700}{2{\cdot}78 \times 60 \times 60} = 2{\cdot}86 \ \square \text{ ft.}$$

On the first floor even a greater section would be required, since there would only be 26 ft. of height available to promote draught, and the equation would become :—

$$v = \sqrt{\frac{64{\cdot}35 \times 26\,(60 - 50{\cdot}4)}{459 + 50{\cdot}4}} = 5{\cdot}6 \text{ ft. per second,}$$

which, multiplied by 0·4, gives a real velocity of 2·24 ft. and an area for the shafts of 3·57 □ ft. It is evident, therefore, that to ventilate naturally by chimneys leads to the use of very large shafts, where the renewal is great, and hence is not of practical utility in cases such as the one under consideration. Of course a higher temperature might be obtained by rarifying the air passed up these flues in some way—either by placing heating surfaces similar to those used in the apparatus for warming, or gas-jets at their base; but since for every degree of increased temperature we should require $2191 \times 0{\cdot}238 = 521$ units of heat per hour, involving the burning of $\frac{521}{7500} = 0{\cdot}07$ lb. of coke in the furnace or boiler, it is manifestly expensive, both in the first instance and in the long run.

It is the more inexpedient seeing that, wherever a heating apparatus, of whatever system, is introduced, there is always a ready means of ventilating at hand—at once inexpensive and powerful.

Suppose, for example, that our class-room forms one of a series of six, and that $6 \times 28700 = 172200$ cubic feet of air require to pass away every hour. All that is required is to build a shaft of moderate dimensions in proximity to the heating-apparatus fire, and to pass the smoke and waste heat from same up an iron flue in the centre. The diameter of the shaft is quickly determined. Assuming that the smoke-flue have an external diameter of 12 in., and that both shaft and flue have a height of 40 ft. as before, the flue will have a surface of $1{\cdot}00 \times 3{\cdot}1416 \times 40 = 125{\cdot}66$ □ ft. Assuming further that the air arriving at the base of the shaft from the rooms have a temperature of 54°, that the mean temperature of the smoke flue is 300° ; the mean temperature of the upcast shaft is readily evolved by aid of the formula :—

$$T = t + \frac{1{\cdot}44\,s\,(t^1 - T)}{2 \times 0{\cdot}238\,w}$$

where s = surface of heating flue in □ ft. ; t^1 = temp. of same in degrees Fahr. ; w = weight of air in lbs. passing up shaft per hour. In our case we find therefore :—

$$T = 54 + \frac{1{\cdot}44 \times 125{\cdot}66\,(300 - T)}{2 \times 0{\cdot}238\,(6 \times 2191)} = 60{\cdot}9^\circ$$

$$v = \sqrt{\frac{64{\cdot}35 \times 40\,(60{\cdot}9 - 50{\cdot}4)}{459 + 50{\cdot}4}} = 7{\cdot}3 \text{ ft. per second,}$$

which, multiplied by 0·4, as before, gives a velocity of 2·92 ft. per second. The area of the main upcast shaft can now be determined, and would be :—

$$0{\cdot}7854 + \frac{172200}{2{\cdot}92 \times 60 \times 60} = 17{\cdot}16 \ \square \text{ ft.} = 4{\cdot}14 \text{ ft. square,}$$

0·7854□ ft. being the space occupied by the flue. In our case we have taken the mean temperature forthe whole year to determine the velocity; but in practice, where the ventilation in school buildings is only intended for winter use, the mean for the winter, or 39·6°, may be employed : and in metropolitan schools, where a far greater height may easily be had for the draught, it will be found that double the above velocity can

readily be obtained. Thus, with a 70 ft. shaft and a winter mean, the velocity would be for equal volumes 16·46, which reduced to practical value $= 16{\cdot}46 \times 0{\cdot}4 = 6{\cdot}58$ per second. From the foregoing remarks, it will be seen that such an apparatus cannot be constructed for any fixed base of ventilation, since the quantity of fresh air passing through a building thus heated will vary inversely with the external temperature—not in direct proportions, since, there are several factors exerting their influence on the result, but still in inverse directions. The only way to obtain a fixed means of ventilation is to employ a fan to drive the air into the rooms in a heated state; but as this involves a better class of attendant, or even a regular engineer, the above method may be considered sufficiently effective for ordinary purposes. Care must, however, be taken that the bases of calculation are sufficiently broad, so that, while the ventilation is ample on warmer days, the heat is sufficient when the outer atmosphere is cold.

The amount of heating surface necessary will vary with the kind of apparatus employed. Thus, supposing the class-room to be heated by steam pipes having a diameter of 3 in. and a temperature of 240°, 46·1 □ ft. of surface would be necessary; if the apparatus, however, contained hot water at a mean temperature of 150°, 111·63 □ ft. of surface would be necessary; again, were a small-pipe hot-water apparatus employed, the use of tubes of $1\frac{5}{16}$ in. external diameter, and having surfaces at a temperature of 237°, 61 □ ft. would be necessary.

To raise the steam apparatus to effective heating point 21280 units would be required, supposing the temperature at commencement to be 40°. To effect the same object in the large-pipe apparatus, there would be necessary, under similar conditions, 63379 units, and for the small-pipe hot-water apparatus 19845 units. Allowing 10 per cent. for loss by connections, &c., the amount of heat required for each apparatus, to keep it at its full effective heat, would be for 10 hours :—

Steam apparatus $\{ 21280 + (17750 \times 9) \}\ 1{\cdot}1 = 199133$ units.
L.P. hot-water do. $\{ 63379 + (17750 \times 9) \}\ 1{\cdot}1 = 245442$ „
S.P do. do. $\{ 19845 + (17750 \times 9) \}\ 1{\cdot}1 = 197554$ „

Supposing that gas coke were consumed, the amount of fuel necessary in each case would be about :—

Steam apparatus $\dfrac{199133}{6500} = 30{\cdot}64$ lb.

L.P. hot-water do. $\dfrac{245442}{6500} = 37{\cdot}76$ lb.

S.P. do. do. $\dfrac{197554}{9000} = 21{\cdot}95$ lb.

C, see page 55.—Extract from a Lecture on "Situation," recently delivered at the Parkes Museum by Mr. E. C. Robins.

The nature of the subsoil, or the stratification of the earth upon which the building stands, is the next important inquiry, but not second in importance. A damp site makes a damp house, not only by the surface dampness of the surrounding ground, but by the ground air, which forces the moisture under and into the house, drawn forward by the means adopted for warming the interior, which, by lightening the weight of the internal air, makes a free passage for the damp ground air in the direction of the least resistance. There are two general divisions in classifying soils, the permeable and the impermeable, and in proportion as the site is free from moisture, in the same proportion is it fitter for residential occupation. But it does not follow that impermeable soils are the driest—on the contrary, it is usually the permeable.

Pervious soils are those like gravel, sand, and soft limestones, which allow of the free passage of water through them, and if there is nothing to obstruct its free passage, and the level of the water in the ground is sufficiently deep, the upper surface upon which the house is built is always dry and healthy. If, however, the gravel has no deep outlet for water which passes into it, owing to its being situated in a basin of impervious soil, so that the level of the water in the soil is brought very near the surface, then it is necessary to find an outlet for the accumulated water by artificial means, called land drainage.

Impervious soils are those chiefly composed of the various clays, which do not allow the waters to sink into their depths, but only suffer it to flow over their surface ; and consequently the garden soil gets

super-saturated, and if the land is level the water is long in getting away, and the evaporation of the moisture, in and upon the soil, produces a humid, damp atmosphere, very injurious to health and requiring very careful surface drainage to overcome.

The public roads, forecourts and areas of houses in a town are usually so well drained that no evil comes from this source, as a rule, in front of the houses; but the back gardens are commonly neglected, and the basements suffer in proportion. It is obviously important to investors in house property, for income or for residential purposes, to look to the surface and subsoil drainage of the site of the house you buy or build, as the case may be. But this is not all. Suburban villas are not always built on natural soils. The brickmaker has sometimes preceded the builder on impervious soils, and the gravel and sand merchant has sometimes sunk great gravel pits for the sale of gravel and sand on pervious soils; and to bring the land to its uniform level, the well-known notice-board has been put up, inscribed, "Rubbish may be shot here," which is only another form for "The seeds of disease sown here." Avoid such sites altogether. I could point to many; but common sense is shocked at the folly and wickedness of raising human dwellings over such abominable deposits. Happily the Public Health Acts all over the country are gradually influencing the age, and the action of the Nuisances Removal Acts, the Local Management and Building Acts, is aiding the public in the acquisition of sounder and healthier dwellings, and instead of grudging the fees paid to District Surveyors and local officers, it would be wiser to secure their influence and direction, and to support their authority. Meantime to obtain a solid and practically impervious basement floor with a surface of wood, provide deal, fir, pitchpine, oak or other wood blocks, 7 by 3½ by 2 inches thick, burnetized, and lay them in herringbone or other patterns, bedded in guaged lime and hair mortar, after first dipping the blocks half their depth in pitch, the whole resting on a solid foundation of ground lime or cement concrete averaging 6 inches thick. The interstices of the blocks should be filled in with Portland cement powder swept over them, the surface to be then washed with water, which, setting the cement in the joints, makes a permanent floor which may be polished. This kind of floor was, I believe, first used by Mr. Gregory from the description of Mr. William White, F.S.A., architect, at a church in Battersea.

D, see page 64.—Extract from a Lecture on "Ventilation, Lighting and Warming of ordinary Dwelling Houses," recently delivered at the Parkes Museum, by Mr. E. C. Robins:—

It is usual to measure the impurity in the atmosphere by the proportion of carbonic acid it contains—not because this is the only or even the chief cause of its unhealthiness, but because the presence of carbonic acid is indicative of the proportional existence of other impurities, namely, foul organic matter and moisture, and also because the amount of carbonic acid can be accurately measured, and therefore may be usefully taken as an index of impurity generally. The average amount of carbonic acid in the air outside of the house, is four parts in 10,000; when it reaches six parts in 10,000 inside, the room begins to be stuffy. Dr. De Chaumont has shown that about 3,000 cubic feet of fresh air per hour are necessary to preserve the air quite fresh; practically, however, no more than 750 cubic feet per hour are attainable in this country without producing draughts. As Dr. Corfield observes:—"The air in our houses is rendered impure in various ways, but chiefly by our respiration, and by the products of combustion that are allowed to escape into it from lights and fires. Thus the air that we *ex*pire contains a certain quantity of foul or putrescent organic matter. It is charged with moisture, and contains about 5 per cent. less oxygen, and nearly 5 per cent. more carbonic acid, than the air we *in*spire." Add to this that every foot of gas consumed is equal to the addition of one person's expiration, and the need of changing the air is quite obvious. This change of air can only be effected by the admission of fresh air and the concurrent abstraction of foul air. It is not enough to provide for the *extraction* of air *without* providing for its *incoming*, because the effort of natural forces seeking equilibrium will cause the air to be drawn through every crevice in doors and windows, and even through solid walls and floor, creating currents of air en route to the motive power, the partial vacuum which the fire in the grate produces. Neither is it sufficient to provide for the *admission* of air, if there is *no means* of *outlet*, and if the chimney-flue is closed it will not enter of itself at all, but will require to be forced into the room, by which process the occupants of the apartment will feel no more delightful sensation than is to be experienced by a descent in the diving-bell at the Polytechnic. In ordinary houses the chimney is a sufficient ventilator when associated with a means of feeding the chimney with a supply of air, to prevent it feeding itself by drawing from every crevice

as afore-mentioned. To feed the fire directly, however, would probably prevent the draughts, but it would decrease the warmth, and leave the room unrefreshed by the change of fresh for expired air. Consequently, it is obviously desirable to introduce the air in such a way that it may do all the good it can before it reaches the fire and is swallowed up by the chimney current. Now it is admitted that the ordinary current up the flue of a sitting-room fireplace is at the rate of from 3 to 6 cubic feet per second, or 300 cubic feet per minute, or 18,000 cubic feet per hour. Consequently, allowing 1,000 cubic feet of air per hour as necessary to be extracted for each occupant of any chamber, obviously one sitting room fireplace is a sufficient extractor for eighteen persons; if 3,000 cubic feet are insisted on, as recommended by Dr. De Chaumont, then six persons are efficiently provided for by this means, which is all sufficient for all practical purposes in dwelling-houses, except on party nights, when a still larger volume of expired air will be required to be extracted, to make way for the equivalent of fresh air which it is necessary to introduce, to keep up the interchange and to maintain the purity of the air generally. Proceeding on this assumption, Mr. Tobin has the credit of putting in practice an old suggestion by the application of vertical fresh air shafts. But the entrance of air through these shafts has to be regulated. This may be done by a hinged lid on the top, with side cheeks opening towards the wall, or by a diaphragm plate hung on centres in the middle of the length of the shaft, and turned with a brass handle at pleasure. In the next place, dust and smoke blacks find their way into the room along with the so-called fresh air. At first, perforated zinc was put in and failed, then cotton-wool was lightly put over, which upset the whole principle by checking the current which was needed to carry the air to the top of the room, that it might fall like the spray of a fountain by its own gravity, only weakened as its temperature was raised by contact with the upper strata of the air of the room.

The Sanitary Engineering and Ventilating Company have contrived a distinct improvement by making use of the horizontal part of the inlet pipe or elbow which passes through the wall as a trap to catch the blacks, by directing the incoming air through iron plates, set at an angle to cause the air to be thrown on the surface of the water, which is held in a tray over which the air must pass. But this freezes in winter, and at Christmas parties, when most air is required, the chances are it is frozen, and the blacks must enter with the air. This has led to another plan being substituted: a canvas bag of the shape of a dame-school fool's-cap is fixed inside, and the air passes freely enough through the extended meshes, and comes in pure and in sufficient force. The lower in the shaft the bag is fixed the better.

The double-hung rising sashes, which I prefer to any other sort of sashes, give a similar kind of access for air, by simply raising the lower sashes 2 inches and fixing a piece of wood to fill up the space below: between the upper part of the lower sash so raised and the lower part of the upper sash which is closed, there will be a space through which the air will pass in an upward direction. Or the same end may be attained by cutting slots in the meeting rails of the sashes, and fixing hit-and-miss brass ventilators over the slots and so admitting or excluding the air at pleasure. Tonks of Birmingham has presented to the Museum Currall's patent for admitting air vertically through the pierced bottom rail of window sashes covered by metal plates directing the current. By no other means is the introduction of cold air directly from without admitted with an upward current at a low level, except through Pierce's pyro-pneumatic, Boyd's last new hygiastic, and H. S. Snell's thermhydric stove; these and others like them stand free of the wall, and the air is brought from without and passed through vertical shafts within the stove-case into the room.

There are a variety of other stoves, which in summer are to be used as cold air admission inlets, so also there are a great many wall ventilators, but none of them deliver the air into the room with a vertical current. At best it is with a cant upwards at an angle of 45° towards the ceiling, like the Sherringham wall ventilator.

Stevens's drawer ventilator, of which an example may be seen in the Parkes Museum, is an attempt to achieve a vertical current from a side opening, but it is not sightly.

Crossley's improved louvre ventilators, both for the admission and extraction of air, are good of their kind and may be seen here.

Boyd, Batty, Edwards, and heaps of stovemakers, arrange for the admission of fresh air through the stove fronts, and very valuable is this means of inlet, because it can be regulated to a nicety by the handle furnished to open and close the louvres, which, in the case of Boyd's School Board stoves, are provided.

In winter time, the value of the introduction of fresh air through the stove is most obvious, because, by taking off the extreme coldness of the outer air, by causing it to pass over warmed surfaces on its way to replace the air exhausted by the attraction of the fire flue; less amount of fuel is required to heat the air of the room than if it came in at the same temperature as the outer air. It is therefore a matter of economy that influences the rejection of any plan which introduces crude cold air, even though it is done without draught on the Whitehurst principle.

The difference between the temperature of the air in the entrance hall and staircase of a house has led to the introduction of door ventilators, for the admission of the cooler air of the hall through brass hit-and-miss ventilators set in the top rail of the door, but this was found to bring the draught straight down upon the occupants between the door and the fire, and consequently Currall's patent door ventilators were invented, to establish an upward current. This principle has received a further development by the architrave ventilator, an apparatus designed by Mr. Judge, the curator of the Parkes Museum. In ordinary dwelling houses hot-water heating is rarely introduced, but if it were, then a most convenient mode of introducing air is available by passing it through a chamber surrounded by a coil of hot-water pipes.

We have now considered the various means of admitting fresh air, and you will have observed my preference for the preservation of a vertical current. And even where that cannot be obtained I think that air should never be introduced directly, but always through a flue built in the wall at a lower level than the opening into the room, so as to break the force of the wind, but at the same time to encourage a vertical current.

Let us now consider *Extract Ventilators.* At present we have remarked only upon the chimney-flue. But there are occasions when it is desirable to supplement this flue, and sometimes there is no fireplace at all, and consequently no chimney by which to ventilate. But supposing that a fire-place *does exist* it is common to supplement it by other appliances: of these Dr. Arnott's chimney-valve, and its varieties, are the earliest and most generally accepted; they are usually fixed, as you know, near the ceiling and form a communication between the upper air of a room and the heated chimney-flue in winter, when there is a fire. And where there is *no down draught* they answer very well, provided proper inlets for air, equal in area to the outlets, are included in the arrangements. In summer, they are also available as ventilators, but down draught is common in flues where there are no fresh-air inlets, or that have no fire to provoke a partial vacuum and consequent upward current therein, the air descending the sooty flue and penetrating the chinks around the talc flaps, (intended to close tightly but rarely doing so). A disagreeable smell is often introduced by this means. For this and other reasons I am not much in favour of ventilating in this way by the chimney-flue. I prefer that a separate flue should be constructed for this purpose, which, going up with or between the heated smoke flues, is sufficiently warmed to rarefy the air and increase the upward current. This special air-flue should be carefully pargeted or lined with plaster, and should not open at the top of the chimney-stack on the same level as the smoke flues, but should open through metal or slate louvres on opposite sides of the stack and about 3 feet below the top. But if it be objected to, as it often is, by those who cannot abide spending money in any form of ventilation—contenting themselves with Mr. Hinckes Bird's so-called costless ventilation (which of course is infinitely better than *none*, and oftentimes is found more effective than *much* that is made to come very expensive)—I say if it is objected to, that this would be equal to doubling the size of the chimney-breasts and backs, then, *don't do it,* but adopt the simple but most efficient plan suggested by Mr. Boyd thirty years ago, and which I myself have carried out in large and in small buildings, but which is particularly suitable for dwelling houses. Instead of making the withe or division between the flues of solid half brickwork (4½ inches), make it a hollow flue by the introduction of cast-iron flue-plates, the thickness of a slate, leaving a clear 4 inches for a ventilating flue warmed on either side by the smoke-flues between which it is situated, and occupying no more space than the ordinary flue withe. I have used these flue-plates to form extract ventilating flues, for the last twenty years, with uniform success. Ordinarily it will be found that there is a sufficient upward draught in extract flues, such as these which I have now described, to form proper exhaust shafts, provided always inlets for fresh air of the same area also exist. But if from any cause there is a failure in the upward current and a down draught is the result, then there are many simple mechanical means for overcoming the evil. In the first place there are a variety of cowls which are so constructed that the action of wind passing by them shall overcome the stagnation of the air in the flue, and give it a tendency to follow in the direction in which the wind is inclined by the form of the obstruction which the cowl presents to its progress. Such cowls are made by Kite, Howorth, Verity, Boyle, Buchan, Banner, and a host of smoke doctors and house-drain ventilaters, and sanitary reformers generally. Some of these are exhibited in the Parkes Museum. But expired air, ventilating or exhaust shafts, carried up with the smoke flues, and therefore opening to the air on the sides of the chimney-stacks through louvres 3 feet below the top of the stacks, cannot have cowls to help the upward draught. In these cases the motive power may be applied at the foot of the shaft, by the application of a small Bunsen burner gas-jet just within the grating, through which the vitiated air makes its escape into the upcast flue. Such ventilators so furnished are made by Mr. Boyd, of 23, Maddox Street, Regent Street. For many years I have used these appliances, and they may be seen in action at various public buildings

erected by me, namely, the National Industrial Crippled Boys' Home, Kensington, in the school rooms and lavatories, the North London Collegiate School for Girls, in the class-rooms and science lecture-rooms, and other buildings.

The introduction of fresh air and the extraction of foul air, simultaneously, both at the upper part of a room, has been attempted with considerable but not unvarying success, by Mr. Potts of Charing Cross and Birmingham. It consists of a metal, or carton pierre, or papier maché, or other hollow cornice, taking the place of the usual plaster cornice, which cornice is divided longitudinally for the whole length of it by a plate attached to the lower portion. The fresh air is admitted from without to the lower horizontal division of the cornice, and is passed into the room through ornamental perforations in the bed mouldings of the cornice. The foul air is extracted through similar perforations in the upper part of the cornice, giving access to the upper horizontal division of the cornice, the outlet pipe from which is taken to an air flue built in the wall, with a cowl on top or a gas jet at bottom, or into a smoke flue, the kitchen chimney flue being preferred as the hottest and most generally available at all seasons of the year, for we must dine! Mr. Robson, the Architect of the London School Board, speaks in commendation of this plan. He says: "I can speak strongly in its favour for facility of application, sightliness, economy of first cost, and self-acting properties. In the case of new buildings, where warm vertical air flues can easily be provided, its action must be so perfect as to induce a very general adoption of the principles of the system."

But it is time that I passed on to the subject of lighting and warming, not that they can ever be treated without reference to ventilation, but rather because ventilation cannot be studied or practised without due consideration of the mode of heating and lighting, intended to be adopted in the room to be ventilated. Indeed, the temperature of the air within a room and without it, being different in density, in the proportion that either is hotter or colder than the other, is one cause of the pressure of one atmosphere against another atmosphere in search of that equilibrium which nature is ever seeking and never finding for any length of time together. "The whistling wind rushing through the woods and forests, bloweth where it listeth and we cannot tell whence it cometh or whither it goeth," until we have traced to its source the provocative cause, which will be found to arise from variations in humidity and temperature and consequent density of pressure of the heavier against the lighter and brighter atmospheres, with which the former impinges against the latter. Thus the draughts in a room are the result of the pressure of the cold air of the street or passage in its struggle to get to the warm air of the room, and particularly to that part of it whence the heat is generated and projected. Where two rooms are of the same temperature the air is stagnant, that is to say, no movement of the air from one to the other will take place by the opening of a means of communication between them. It is obvious, therefore, that if the whole of the interior of a house were equally warmed there would be no change of air between one part of the house to another, and the building would be in the most favourable condition for the introduction of the means of special ventilation already described. Each room might be separately lighted, warmed and ventilated, and yet the same temperature might be maintained, but with the difference that there would be no stagnation, but pure fresh air warmed as it entered for free inspiration, and withdrawn as by expiration or combustion it became impure.

Now this Utopia is not to be attained if the hall and passages and the staircases be not considered in the general warming of the house—for myself I am much impressed with the economy in heating an interior which comes from first warming the lungs, so to say. The best salvation from the wasteful consumption of fuel, is the withdrawal of the cause of the draughtiness of rooms, arising from the otherwise uncontrollable difference in temperature between the sitting-room and the hall, by the introduction of a good hall fire or other system of warming the entrance hall and staircase.

With reference to the lighting of rooms, of course, the softest and most agreeable method of lighting is by wax candles; but the expense of this method precludes its general adoption, except in the drawing-rooms and boudoirs of the rich. But there are many candle lamps (with reflectors for reading, and without them for general lighting) which were in common use before the introduction of colza oil, paraffin, and other lamps. The inconvenience attending the preparing and cleaning of such lamps has, however, lessened their use, and the cheapness and ready application of gas has led to its most general adoption. The brilliancy of its light too, when once it has been experienced, adds so to the cheerfulness of the house that it has superseded in a great degree every other. But as Dr. Corfield observes, in the little book I recommended to you in my first lecture, candles, lamps and gas all help to render the air impure. It is calculated that two sperm candles, or one good oil lamp, render the air about as impure as one man's respiration does, whereas one gas burner will consume as much oxygen and give out as much carbonic acid as five or six men or even more. This is why

it is commonly considered that gas is more injurious than lamps or candles; and so it is, when the quantities of light are not compared; but with the same quantity of light, gas renders the air of a room less impure than either lamps or candles. If, in the dining room, instead of using five or six gasburners, as we too often do, without any provision for the escape of the products of combustion, we used forty or fifty sperm candles instead of six or eight, we should have a fairer comparison between gas and candles. Common sense at once suggests that the products of combustion should be carried away, and the heat generated by the process should be utilized to expedite its removal, and several manufacturers have turned their attention to this desirable end.

Messrs. Strode's sunburner, used for lighting large assembly-rooms, is conceived on this principle. Thirty or forty or more gas-jets are placed close together under an enamelled iron reflector, from which the heated air is conducted, through the roof or floor, to the exterior. This first tube is inclosed in a second tube forming a jacket a few inches from the first, which is employed to withdraw the expired air of the apartment.

Messrs. Benham and Sons have provided a globe light for use in ordinary apartments, which is very ingenious and effective. The globe is suspended from the ceiling and is open at the top; the suspension rod is a hollow tube into which the glass chimney surrounding the burner conveys the products of combustion, which are carried away through tubes to the exterior or into a chimney flue. A metal jacket surrounds this tube in the thickness of the floor, and the ornamental rose, forming the junction between the pendant and the ceiling, is pierced to allow of the exit of the vitiated air of the apartment. But in addition to this, between the rose and the ceiling is a small space through which fresh air is admitted to feed the light, thus at once adding to its brilliancy and replacing the air withdrawn by the extracting tubes.

Messrs. Richardson, Ellson and Co. have many ventilating contrivances and they publish them in a separate catalogue.

A still simpler and less expensive arrangement is Messrs. Faraday and Son's ventilating gas pendant, also exhibited in the Parkes Museum. This pendant is designed to afford a strong concentrated light with means for carrying away the products of combustion. The gas supply pipes are fixed outside the ventilating shaft, which is thus kept clear of obstruction for the purpose of securing a good draught. Screens of opal glass are provided to soften the light which can easily be removed for cleansing. The trumpet-shaped glass, terminating the ventilating shaft, is released by simply pinching the buttons of the spring clip together. The argand burner is fitted with a lever check to regulate the flame. Horizontal extract tubes connect the upper end of ventilating tube with the exterior or flue.

General Franzini has presented to the Parkes Museum his patent globe reflector. This lamp consists of two hemispherical pieces of crystal—one of these is a bottle used to contain filtered water. The other is of opal, in which may be placed gas, oil, electric or any other light. The light placed between the two crystals is magnified by the water; with the globe is included a conductor to carry off heat, smoke and smell from the burning light into the water.

The same person has invented what he terms the "Healthy" gasburner, and presented one to the Museum. It consists of two small burners fixed side by side to secure more perfect combustion, and an increased amount of light, from a given quantity of gas. The two flames blend together in one large flame and give seven times the light, with no greater expenditure of gas and less product from combustion.

The Silber Light Company have a similarly contrived burner, which I have introduced into my own office with great advantage; a special globe is made for it, and the result is a clear, bright, steady flame like an argand.

With regard to gasburners generally, they should be provided with some disc (in steatite or terra cotta), or other means of checking the pressure, and that the orifices should be large and also of some non-corrosive material.

The Brönner and the Bray are good flat flame burners, and the Sugg and the American "regulator" as argands or "ring" flames. Any of these give a good light in proportion to the gas consumed, and are vast improvements upon the burners made of iron or brass, without pressure check, and drilled with very small orifices, such as were commonly in use till the last three or four years.

The Bunsen, or air and gas burner, is still much used for heating purposes, as it has something of the energy of the blow-pipe and makes no smoke. A small one of this class may be seen in Faraday's nursery or kettle bracket in the Parkes Museum, and it is now being adapted for stoves, something on the principle recently advocated by Dr. Siemens.

The electric light will be soon a household thing, and then we shall have no products of combustion to think about, and no injury to our furniture and frames to deplore.

Gas stoves for cooking purposes are various and economical—from the simple ring of gas-jets, mixed or unmixed with air, to the vast machinery in use at the London Hospital, where £400 a year is saved by the use of Leoni's gas cooking apparatus.

Gas stoves for warming are highly convenient, though not at present economical for continuous use ; but for occasional employment they are most economical, and by the arrangement of pumice stones, asbestos, terra cotta lumps, or a combination of all three, very bright and sparkling furnace-looking fires with considerable radiating power are attainable.

Hall stoves may be usefully contrived for burning gas since they need no tending and take no space. But for ordinary room fires it will be long before we shall be able to dispense with wide and open coal fires. Nothing can compare with them in the opinion of the home-loving British public. Certainly nothing is more healthy, cheery or wasteful. We cannot give it up for the close stoves of the Germans or the Americans, and so we may as well turn our minds to its improvement.

The natural process by which the temperature of the air is raised is either by radiation or conduction. Conduction or rather conducted heat is the warmth given off by any surface by direct contact with any substance, whether air or otherwise. Radiated heat is like that of the sun which passes through the air as light without heating it, into the earth or any intervening substance, from which the heat is given off gradually to the atmosphere, creating the difference between sun and shade temperature. Thus it is that the conducted heat of an open fire goes up the chimney—and about a sixth part is radiated into the room, passing through the air without sensibly heating it—but warming the first obstacle to its free passage, such as the inclosing walls and furniture, by which the radiated heat is given off to the air of the room, raising its temperature as required. It cannot be called an economical mode of heating, but it is the most enjoyable and most healthy. All the products of combustion pass up the chimney and draw after them the impurities and denser air of the room lying lowest, whilst the vivifying rays of the crackling fire heat without scorching the surfaces that warm the air of the room insensibly.

The primary but not the exclusive object in the improvement of an open fire stove, must obviously be the increase of its radiating power by reflection from heated polished surfaces in close contact with the fire, and this is done by many of the best stoves. One of the best forms is where the fire-cheeks are of polished steel, set at an angle of 45° with the back of the stove and projecting in front of the fire-bars, so as to receive the brightest radiation—the upper part of the front of the stove being made to be set at a similar angle to the same end and the hearth of encaustic glazed tiles, or covered with a radiating steel fender. Such a stove has an immense power of radiation, and many old fashioned stoves are so constructed.

The latest improvement with this design is the new register stove, patented by Messrs. Comyn Ching & Co., called "The Paramount." In this case the fire-grate or basket is quite disconnected from the brickwork surrounding it, and equally so from the metal case, or shell or encaustic tile lining of the chimney back and sides, excepting only at the point of contact with the bracket which supports it, giving a free space all round. Thus the fire is enabled to radiate as from a centre ; the rays of heat emitted from the back of the fire-basket impinging on the metal reflector, or on the tiled lining of the fireplace, are reflected forward into the room and utilized instead of lost, as heretofore. This back reflection plate and centrally fixed rotary movement of the fire-basket is novel, and calculated to economize fuel, promote cleanliness, insure uniformity of combustion, double the radiating power, and being moveable, may be carried from one room to another. The letters to the *Times* of "Another Country Parson" and the late Mr. Mechi, of Tiptree Hall, drew the public attention to a valuable series of economical slow combustion, yet large radiating fire fronted stoves, made by Messrs. Barnard and Bishop of Norwich. These stoves heat by direct radiation, and have no reflecting surfaces. The bars are six in number, and of various widths to suit the size of the rooms to be heated. They are rightly called the "Front Fire Grate Stove," and are fitted with blowers to encourage the draught at pleasure. The bottom of the grate is closed (which produces slow combustion) and within 4 inches of the hearth to which it slightly inclines ; the sides, back and bottom are of terra cotta.

E, see page 56.—TABLE by Dr. De Chaumont to show the degree of contamination of the air (in terms of carbonic acid) by respiration, and the amount of air necessary to dilute to a given standard of ·6 per 1000 volumes of air, of which ·4 is the carbonic acid naturally existing, and ·2 is from respiration. In the table a deduction is made of the initial ·4 volumes of carbonic acid per 1000 for the sake of clearness :—

Amount of cubic space (=breathing space) for one man in cubic feet.	Ratio per 1000 of carbonic acid from respiration at the end of one hour, if there has been no change of air.	Amount of air necessary to dilute to standard of ·2, or including the initial carbonic acid, of ·6 per 1000 volumes, during the first hour.	Amount necessary to dilute to the given standard every hour after the first.
100	6·00	2900	3000
200	3·00	2800	3000
300	2·00	2700	3000
400	1·50	2600	3000
500	1·20	2500	3000
600	1·00	2400	3000
700	0·85	2300	3000
800	0·75	2200	3000
900	0·66	2100	3000
1000	0·60	2000	3000

*** Mr. James Mansergh, of Victoria Street, Westminster, writes :—Mr. Rogers Field says that the open-air disconnection between the housedrain and the sewer was a new point of departure. I believe the little gully which bears my name was the first in which this principle was distinctly recognized, although I confined its use to the wastepipes from cisterns, sinks, lavatories, baths, &c., and dealt with the water-closets by carrying the soilpipes above the roofs. I designed this trap in January, 1868, in consequence of having been asked by Mr. Rawlinson to superintend some alterations at the house of Mr. John Simon, then the chief of the medical department of the Privy Council. At that time I ransacked all the yards in Lambeth, but could find nothing to effect what I wanted, namely, first, with certainty to prevent a back flow of foul air into the house ; secondly, to avoid the nuisance of having slops frozen and grating stopped where they were delivered on the surface ; thirdly, to provide a small receptacle which should require frequent attention in place of the large foul grease-traps common in large houses. The cutting off water-closets in addition on the same principle (which I have done for some years), and the provision of an inlet for fresh air, are no doubt most valuable improvements, but with regard to the system devized by Mr. Norman Shaw, although I would not quarrel with the principle I consider the mode of application objectionable. In a house in my neighbourhood there are several bare lead pipes of various sizes, planted against the walls and finished with plain hopper heads nearly under and at no great distance from windows. If there is no actual nuisance to the sense of smell from these openings they are in my opinion needlessly unsightly and unpleasantly suggestive. Where a few pounds' expense are no object I think the following mode of treating a soilpipe, which I have recently adopted in a new house, is less objectionable. On the first floor against an outside wall 18 inches thick were a water-closet and a slop-closet adjoining each other. A chase 9 inches wide and 4½ inches deep from the outside face was left in the wall, and this was made into a 9-inch square chamber by building a 9-inch projection. In this chamber a 4-inch Stanford jointed stoneware pipe was carried up vertically and surrounded with fine concrete. A little below the level of the first floor this pipe was finished with a lead hopper, and the discharge pipes from the two closets were brought from their respective traps and turned down so as to deliver fairly into this hopper. At this point an iron door was built in on the outside for inspection, and then the 9-inch chamber or flue was carried up like a chimney and—pending the result of the battle of the cowls—finished with a plain bell-mouthed terminal. Of course at the low end of the housedrain there is a proper disconnecting chamber and fresh air inlet. In this arrangement, which has answered perfectly, the soilpipe is kept out of the house, is most efficiently ventilated, and in my opinion is in no degree unsightly, because it is taken for an ordinary chimney.

[To face page 124.

SANITARY SCIENCE IN ITS RELATION TO CIVIL ARCHITECTURE.

APPENDIX E (*continued*), see page 56.

TABLE to show discharge of air in linear feet per minute calculated from Montgolfier's formula. The expansion of air being taken as 0·002 for each degree Fahrenheit, and one-fourth being deducted for friction (round numbers have been taken):—

DIFFERENCE BETWEEN INTERNAL AND EXTERNAL TEMPERATURE.

Height of Column.	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	30	Height of Column.
10......	88	102	114	125	135	144	153	161	169	176	183	190	197	204	210	216	222	228	233	239	244	249	254	279	10
11......	92	107	119	131	141	151	160	169	177	185	192	200	207	213	220	226	233	239	245	250	256	261	267	292	11
12......	96	111	125	136	147	158	167	176	185	193	201	209	216	223	230	237	243	249	255	261	267	273	279	305	12
13......	100	116	130	140	153	164	174	183	192	201	209	217	225	232	239	246	253	259	266	272	278	284	290	318	13
14......	104	120	135	147	159	170	181	190	200	209	217	225	233	241	248	255	262	269	276	282	389	295	301	330	14
15......	108	125	139	153	165	176	187	197	207	216	225	233	241	249	257	264	272	279	286	292	299	305	312	341	15
16......	111	129	144	158	170	182	193	204	213	223	232	241	249	257	265	273	281	288	295	302	309	315	322	353	16
17......	115	133	148	162	176	188	199	210	220	230	239	248	257	265	274	282	289	297	304	311	318	325	332	363	17
18......	118	136	153	167	181	193	205	216	226	237	246	255	264	273	282	290	298	305	313	320	327	335	342	374	18
19......	121	140	157	172	186	198	210	222	233	243	253	262	272	281	289	298	306	314	321	329	336	344	351	384	19
20......	125	144	161	176	190	204	216	228	239	249	259	269	279	288	297	305	314	322	330	338	345	353	360	394	20
21......	128	147	165	181	195	209	221	233	245	255	266	276	286	295	304	313	321	330	338	346	354	361	369	404	21
22......	131	151	169	185	200	214	226	239	250	261	272	282	292	302	311	320	329	338	346	354	362	370	378	414	22
23......	134	154	173	189	204	218	232	244	256	267	278	289	299	309	318	327	336	345	354	362	370	378	386	423	23
24......	136	158	176	193	209	223	237	249	261	273	284	295	305	315	325	335	344	353	361	370	378	386	394	432	24
25......	139	161	180	197	213	227	241	254	267	279	290	301	312	322	332	342	351	360	369	378	386	394	402	441	25
26......	142	164	183	201	217	332	246	259	272	284	296	307	318	328	338	348	358	367	376	385	394	402	410	450	26
27......	145	167	187	205	221	237	251	264	277	290	302	313	324	335	345	355	365	374	383	392	401	410	418	458	27
28......	147	170	190	207	225	241	255	269	282	295	307	319	330	341	351	361	371	381	390	399	408	417	426	467	28
29......	150	173	194	212	229	245	260	274	287	300	312	324	335	347	357	368	378	388	397	407	416	425	433	475	29
30......	153	176	197	216	233	249	264	279	292	305	318	330	341	353	363	374	384	394	404	414	423	432	441	483	30
31......	155	179	200	219	237	253	269	283	297	310	323	335	347	358	369	380	391	401	411	420	430	439	448	491	31
32......	158	182	204	223	241	257	273	288	302	315	328	341	353	364	375	386	397	407	417	427	437	446	455	499	32
33......	160	185	207	226	245	261	277	292	307	320	333	346	358	370	381	392	403	414	424	434	443	453	462	506	33
34......	162	188	210	230	248	265	282	297	311	325	338	351	363	375	387	398	409	420	430	440	450	460	469	514	34
35......	165	190	213	233	252	269	286	301	316	330	343	356	369	381	393	404	415	426	436	447	457	467	476	522	35
36......	167	193	216	236	255	273	290	305	320	334	348	361	374	386	398	410	421	432	442	453	463	473	483	529	36
37......	170	196	219	240	259	277	294	310	325	339	553	366	379	392	404	415	427	438	448	459	470	480	490	536	37
38......	172	198	222	243	262	281	298	314	329	344	358	371	384	397	409	421	432	444	454	465	476	486	496	543	38
39......	174	201	225	246	266	284	302	318	333	348	362	376	389	402	414	426	438	450	461	471	482	492	503	551	39
40......	176	204	228	249	269	288	305	322	338	353	367	381	394	407	420	432	444	455	467	477	488	499	509	558	40
45......	187	216	241	264	286	305	324	341	358	374	389	404	418	432	445	458	471	483	495	506	518	529	540	591	45
50......	197	228	254	279	301	322	341	360	377	394	401	426	441	455	469	483	496	509	522	534	546	558	569	623	50
Height of Column.	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	30	Height of Column.

To use the foregoing table, determine the height of the warm column of air from the point of entrance to the point of discharge. Ascertain the difference between its temperature and that of the external air. Take out number from table and multiply by the section area of the discharge tube or opening, in foot or decimals of a foot. The result is the discharge in cubic feet per minute, multiply by sixty—result, discharge per hour.

EXAMPLE.—Height of column, 32 feet; difference of temperature between internal and external air, 17 deg. Looking in the table, we find opposite to 32 and under 17, 375 feet. That would be an area of one square foot.

But supposing our air opening to be only $\frac{3}{4}$ of a foot, we must multiply 375 by $\frac{3}{4}$ or 0·75 of a foot.

$$\left\{\begin{array}{r} 375 \\ \underline{\cdot 75} \\ 1875 \\ \underline{2625} \\ \underline{\underline{281{\cdot}25}} \end{array}\right\}$$

Therefore we get 281 feet (per minute), multiplied by 60=16,860 feet per hour.

If the movement of the external air influences the movement in the room, as when the wind blows through openings, calculation is useless, and the anemometer only can be depended on.

[The foregoing table and description are extracted from *A Manual of Practical Hygiene*, by Edmund A. Parkes, M.D., F.R.S.; fifth edition, edited by F. S. B. François de Chaumont, M.D. London, J. & A. Churchill, 1878.]

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IV. REMAINS OF ROMAN BUILDINGS AT MORTON, ISLE OF WIGHT.

By Mr. JOHN E. PRICE, F.S.A. AND Mr. F. G. HILTON PRICE, F.G.S.

[Read on Monday, 13th December, 1880, John Whichcord, F.S.A., *President*, in the Chair.]

THE discovery of Roman buildings at Morton, between Brading and Sandown, contributes a chapter of no ordinary interest to the history of the Isle of Wight. So little is actually known of its condition, either prior or subsequent to the Roman occupation, that any information calculated to augment the scanty materials possessed will be readily welcomed by the historian and archæologist. In attempting, however, a description of the discovery made, it becomes desirable to place on record such facts as have been well authenticated, which bear upon the early history of the Island. With the exception of the indications of buildings discovered some years ago along the coast line by Gurnard Bay, and since demolished by the encroachments of the sea, the villa at Carisbrooke has up to the present time, enjoyed the distinction of being the only illustration of a veritable Roman building existing in the Island. Etymology, however, has preserved a singular proof of Italian influence, namely, in the letter W in Wight: the Roman consonant V,* long after the Imperial rule had ceased, continued to be pronounced as W by the native tribes. To the Belgæ, Venta and Vectis meant Went and Wight, as did *Vinum* wine. Pottery also, with coins, urns, tiles and sepulchral relics, have in more than one locality afforded ample testimony to the presence of Romans or Romanized Britons in the Island, but it does not appear, with the exception of the illustrations mentioned, that any indications of domestic settlement, of a building or buildings adapted to either private or public uses, which could be associated with the conquering race, has until now been recorded. It is well known that the insular position enjoyed by Britain was an advantage well appreciated in the great scheme of colonization, and this doubtless was no less an attractive force in the case of the Isle of Wight. The colonizing expeditions which left the shores of Italy would include in their ranks many for whom the beauty of the climate and the charming scenery of Vectis would provide a genial home. The native Belgæ, a warlike race, slow to yield, though disaffected among themselves, soon learned to appreciate the advantages of the organization under which they were to live, and to value the sense of security attained; trade and commerce naturally became stimulated, and the valuable natural products of the Island turned to account under the influence of civilizing arts and manufactures. A combined and increasing population would soon develop resources at command, and as time rolled on, the Island would become, both in a commercial and military sense, an addition of some importance to the growing and prosperous province of Britain. That it was annexed to the Empire towards the middle of the first century is well authenticated. Vespasian, at the time when Claudius was engaged in Britain, was in command of the Second Legion in Germany; of this he was legate, and with it he came to Britain to assist in the enterprize. Suetonius records how he engaged the enemy in thirty battles, reduced two powerful tribes, captured twenty towns, and subdued the Isle of Wight. Similar testimony is also rendered by Eutropius. It is to be assumed, therefore, that

* See *The Romans of Britain*, by Henry C. Coote, F.S.A., London, 1878. 8vo.

it was the Second Legion which, as a military force, first occupied the Island, but of this we have no evidence at present. This division of the Roman army was longer in Britain than any other; arriving with Vespasian it remained until the close of the occupation, having, at the time of the compilation of the *Notitia*, its head-quarters at Richborough, in Kent.

Late in the third century, Vectis is again mentioned, but only incidentally; Constantius had prepared to invade the province which Carausius had severed from the rule of Diocletian and Maximian. Allectus, the successor of Carausius, stationed a portion of the Romano-British fleet off the Isle of Wight to intercept the invaders under the prætorian prefect Asclepiodotus, but a dense fog so obscured the ships coming from Gaul, that they passed unobserved, and gained the coast of Britain in safety. These appear to be the only trustworthy references in classical literature connected with the Island, but much has been written by various authors, whose learning and experience entitle them to respect, to prove the identity between Vectis and the Ictis of Diodorus Siculus. The Greek historian speaks of an island lying off Britain as one where the natives were accustomed to convey tin, extracted from the Cornish mines, in waggons at low tides across the mainland, and thence to Gaul for shipment to other lands. The late Mr. Thomas Wright refers to the identification of the island as being "*in front of Britain*," and that the tin when purchased from the miners was transported to Gaul and carried overland on packhorses a journey of thirty days to the mouth of the Rhone. The arguments learnedly set forth by Dr. Whitaker, the historian of Manchester, and by the Rev. Edmund Kell, F.S.A.,* of Newport, also deserve careful study and attention, especially in their relation to present discoveries, for it may hereafter be shown that, in the remains now in course of investigation, there are traces of such an important settlement in the vicinity of Brading as can only point to trade and commerce, practised may-be for centuries, but the actual proofs of which have yet to be ascertained.

The connection of the Island with the Saxon rule may be briefly referred to, for it strangely marks the sequence of history. At the collapse of the Empire, the military forces of Rome were withdrawn from its numerous and distant provinces, and with many other prosperous settlements in this, one of the most loyal of the dependencies of Rome, Vectis was subdued by the Saxons. The chronicler Bede, under the year A.D. 449, and some thirty years after the Roman Government had ceased, speaks of the German tribes who arrived in Britain, and among them the Jutes, whence came the "Kentish-men" and the "Wightwarians," the latter a tribe which, as he writes, "now dwells in Wight." Again, in A.D. 530, Cerdic and Cynric conquered the island and slew many men at Wight-garas-byrg, now known as Carisbrooke. In A.D. 534, it is recorded by the same writer, "they gave the whole island of Wight to their two nephews, Stuf and Wightgar." Our learned friend Mr. H. C. Coote, F.S.A., in his recent work, *The Romans of Britain*, refers to the "doughty Wihtgar" as a nonentity, and that on dissection he is no other than a reproduction of *Wightwara*, the men of the Isle of Wight; Wihtwara byrig, he remarks, the city of the men of Wight, was so called by the Jutes in supercession of its true Roman name, just as Durovernum was called by their brethren "Cantwara byrig," the city of the men of Cantium; Wihtwarabyrig is the modern Carisbrooke. Succeeding writers turned this into Wightgares-byrig, the castle of one Wightgar, and thus Wightgar became an entity. Under the year A.D. 661, in the *Anglo-Saxon Chronicle*, we are told that one Wulfhere

* See the Journal of the British Archæological Association, vol. xxii, p. 351.

the son of Penda, laid waste Wight and gave the people of Wight to Ethelwald, King of the South-Saxons, because Wulfhere had been his sponsor at baptism; and Eappa, the mass-priest, by the command of Wilfrid and King Wulfhere, was the first of men who brought baptism to the people of the Isle of Wight. The entry is of interest to our present inquiries from the connection it has with the introduction of Christianity to the Island. Dr. Lappenberg in his *History of England under the Anglo-Saxon Kings,** speaks of the hard fate which befel the Isle of Wight, which had been severed from the Kingdom of Wessex by Wulfhere of Mercia, and ceded to Sussex, though governed at the time by its own prince. The twelve hundred families which were dwelling in the Island were nearly all slaughtered. Dr. Lappenberg writes that at this period the Island had not embraced the teachings of Christianity, and that the slaughter was effected by the then unbaptized Ceadwalla, in fulfilment of a vow that, if he took the Island, he would devote to Christ the fourth part both of the land and spoil. This he performed by assigning it to Wilfrid, Bishop of Wessex, who happened to be present for religious purposes; by him the same was transferred to his nephew Bernwin, who, assisted by a priest named Hiddila, effected the conversion of the island. The Danes are said to have been in possession in A.D. 787, but as to how long they held it, is doubtful, for in the reign of Alfred they are reported as again landing and plundering the inhabitants. It was twice plundered by Earl Godwin in the reign of the Confessor, and again by Earl Tosti in the time of Harold. In *Domesday Book* the number of families is set down as 1,124 only.† The reference therein to Carisbrooke indicates that it was, then, an important position in the Island, the pioneer it has been termed of Newport, and in its Roman buildings, not yet sufficiently explored, are the indications of its origin. Newport, at the head of the river, which, marking a natural division in the island with the two Hundreds of East and West Medina defines the capital, suggests in the modern configuration of its streets the familiar plan so universally adopted in the formation of a Roman town. The Saxon interments, discovered in the cemetery on Chessell Downs, favourably compare with similar remains in Kent; the contents of the graves possess a marked resemblance, and as remarked by Mr. Roach Smith, F.S.A.,‡ there are points of analogy which indicate a close relationship between the Saxons of the Isle of Wight and those of Kent, such as seem to bespeak a more than general affinity, and tend to show that Bede, when he wrote that the people of Kent and the Isle of Wight descended from a common origin (the Jutes), had good authority, either written or traditional, for the assertion.

The local histories unfortunately contain but little information as to the presence of Roman antiquities; indeed Sir Henry Englefield,§ writing in the year 1816, remarks :—*"Of the Romans there is not a vestige in the island, and it is singular that not even a coin should have*

* See *A History of England under the Anglo-Saxon Kings*, by J. M. Lappenberg, translated by B. Thorpe. Lond. 1845. 8vo.

† *Introduction to Domesday Book, &c.*, by Sir H. Ellis, Lond. 1833. 8vo. :—

Tenants in capite	37	Servi	8
Under Tenants	45	Vavassores quidam habens vaccas	11
Bordarii	441	Villani	360

‡ See *Collectanea Antiqua*, by C. Roach Smith, vol. vi., p. 150.

§ See *A Description of the Principal Picturesque Beauties, Antiquities and Geological Phenomena of the Isle of Wight*, by Sir H. C. Englefield, Bart. Lond. 1816. 4to.

ever been found excepting five mentioned by Mr. Warner, which were discovered in a field near Carisbrooke, and which seem to have been accidentally dropped there. When it is considered that they had very considerable establishments at Porchester and Bittern, near Southampton, and that the Isle of Wight must have been a most convenient station for an army, secure if its numbers were small, and affording every advantage to the most considerable body of forces, it is not a little extraordinary that it should have been so totally neglected. It appears to have been equally free from the operations of war in Saxon times, as not a single vestige of any camp or entrenchment is discoverable upon it. Mr. Wyndham, whose accuracy of research is well known, visited every part of the island for the express purpose of investigating the subject, and his research was fruitless." Sir Richard Worsley also in his *History of the Isle of Wight,* a work abounding in information, writes to similar purpose. Some forty years, however, after the publication of Sir Henry Englefield's work, the important discovery was made to which we have already referred: a Roman villa was found by Mr. W. Spickernell at Carisbrooke, which found an able chronicler in the late Mr. George Hillier, who published an account of his own investigations.* The remains of the villa thus uncovered were in the grounds of the Vicarage House, and they were announced to the world as the first discovery of a building associated with the Roman occupation of the Isle of Wight. These remains have never been thoroughly explored, nor indeed their extent ascertained; the excavations have been carefully protected, and are of considerable interest. They contain good examples of mosaic, a bath with its hypocaust, wall paintings, roofing-tiles, pottery and other objects. The portion uncovered is 118 feet long by about 49 feet wide, inclosing several chambers, with a small semi-circular compartment strongly resembling one recently developed at Morton. The coins were few in number, but they were of late date, and comprized examples of Gallienus, Postumus, and the Constantine family.

In 1833, two distinct hoards of Roman coins were discovered. One collection was found at Cliffe, near Shanklin, and comprized no less than six hundred brass and six silver coins, chiefly of the reigns of Theodosius, Arcadius and Honorius, inclosed in an urn. The other, found in the same year in Barton Wood, a spot now belonging to the Queen, consisted of nearly a gallon measure of Roman brass coins. They had been inclosed in a box and became so amalgamated and corroded that separation was difficult; examples were, however, identified of Augustus, Trajan, Antoninus Pius, Lucius Verus, and of Faustina, wife of Marcus Aurelius. In 1854, the Rev. Mr. Kell, records some excavations by the late Mr. George Hillier, on Brightstone and Bowcombe Downs: certain barrows were examined and found to contain interments by inhumation associated with personal objects in metal, with coins of late date.†

In 1862, while excavating for the Cowes and Newport railway, a stratum of earth was intersected which contained a considerable quantity of broken urns and amphoræ, together with wood ashes, and it is stated with calcined bones. These remains were found near to the town of Newport.‡

In 1863, a discovery occurred at Farringford, near Freshwater, the seat of Mr. Alfred

* See *History and Antiquities of the Isle of Wight,* by George Hillier; also *Collectanea Antiqua,* C. Roach Smith, vol. vi. A plan, copied from that published by Mr. Hillier, of the Carisbrooke villa is given at page 88 of the PROCEEDINGS, 1880-81.

† See the Journal of the British Archæological Association, vol. xix., p. 307, and vol. ii., p. 36.

‡ See the *Gentleman's Magazine,* Feb. 1862.

Tennyson, the Poet Laureate. An urn was found containing no less than two hundred and fifty Roman coins, examples of Gallienus, Tetricus, Postumus, and Claudius Gothicus. In a letter recently received from Mr. Tennyson we learn that, near to the urn, was a horse's head surrounded by a circle of stones. In 1867, Mr. Roach Smith reported the finding of Roman remains at Combly, upon the northern side of Arreton Downs, and upon the farm, Mr. John Lock, jun., discovered vestiges of Roman buildings. Roman urns of large dimensions have been found at Swanmore, near Ryde, and they are deposited in the Museum of that town.

In 1864, the discovery of Roman buildings to which we have briefly alluded, occurred at Gurnard Bay; the remains adjoined an ancient way known as Rue Street, a road which, according to the Rev. Mr. Kell, proceeds in a direct line through the Island from Gurnard Bay to Niton and Puckaster Cove. The coins found were of a good period, examples of the reigns of Vespasian and others of the age of the Antonines. The pottery, roofing-slabs, nails and other objects, strongly resemble those recently found at Morton, and point to a common date. One of the most interesting features, however, was the discovery of a large number of leaden *bullæ*, or tickets, which, from the letters and designs upon them, were seen to be of Roman date, and had doubtless served as marks or seals attached to some description of merchandize. Indications of Roman occupation have further been traced at Brixton and Clatterford, Newtown, Bonchurch, and indeed in many other parts of the Island.

The foregoing facts tend to show what important changes have been produced in the district by the action of the sea since the withdrawal of the Roman legions, and how great must be the change which has taken place in the configuration of the land; the extensive system of embankment, either executed by the Romans, or those who immediately succeeded them, has considerably altered its geographical character, and it is thought that when the present explorations are more advanced, careful study will show that the locality has been one of vast importance in the maritime operations of a now remote period. In few parts of the Island are these changes more apparent than in the immediate vicinity of Brading. At high water the haven has all the appearance of a lake; it incloses an area of 840 acres opening to the Solent, between the headlands of Bembridge and St. Helen's. At low water it is mostly an expanse of mud, with a narrow channel through which the Yar meanders to the sea. Many attempts have been made to reclaim this valuable tract, but without avail. It is said that, in the course of an attempt to throw an embankment across the mouth (which the sea quickly washed away), a well cased with stone was found. It was near to the middle of the haven, demonstrating that its site had once been dry land, and that the sea had overflowed it within the historical period. Captain Thorp, of Yarbridge, is under the impression that he has discovered an ancient ford in the direction of Yaverland and the shore line. We have recently come across indications of traffic in the direction of this spot. It may probably be found to have some connection with an interesting site, known as Centurions Copse, a name preserved by tradition and strangely suggestive of military occupation. There are traditions of ancient buildings having once existed in the vicinity of Woolverton Wood, and pieces of carved stone, heaps of rubbish and broken pottery, have been found. Aged residents speak of bits of masonry and traces of foundations in adjoining fields. The existence of such walls can be now readily understood, for they can well be associated with the Roman settlement at Brading. All surface materials, however, that could be utilized, either by the builders of the middle ages or of later times, have

gradually disappeared. Associated with this locality are remains said to belong to a mediæval chapel, but which are probably to be connected with a much earlier period.

The site of the buildings now in course of excavation is a remarkably fine one. At the present time these remains lie partly on the property of Lady Oglander, of Nunwell, the Nonelle of *Domesday Book*, an estate of some extent and of historical interest, including within its boundaries many sepulchral barrows, foundations of ancient buildings, and other matters of archæological value. The other portions of the remains now in course of exploration are on the property of Mrs. Munns, the line of demarcation running through three of the apartments excavated. The two fields are known respectively as "Seven Acre Field" on one side, and "Ten Acre Field" upon the other, forming together an elevated site, which, looking towards the high road separating them from the lowlands and marshes, appears as a gentle slope of cultivated land. Looking seawards, there is to the left Brading Down and the bold chalk range of hills terminating in the promontory of Culver Cliff, while to the right is the growing town of Sandown, with the picturesque hills and vales leading onwards to Shanklin and Ventnor. Skirting Brading Down, and marking a boundary line to the field in which our excavations are situated, is a fosseway, which as a bridle path has probably in turn been used by Celts, Romans and Saxons; it runs at the base of the hills by Arreton and Gatcombe to Newport and Carisbrooke. At very high tides the position is one mostly covered by water, the site as selected by the Roman colonists was then insulated, so to speak, from Bembridge Down and the adjoining heights; but the indications, already referred to, of buildings at Brading Haven show how much has yet to be investigated, in a geographical point of view, ere any opinions can be confidently expressed.

The present explorations originated in finding on Mrs. Munns's property such indications of Roman buildings as offered encouragement for further investigation. On this land, walls, roof-tiles, and traces of pavements, were discovered by Captain Thorp. Early notice of the discoveries then made was communicated to the *Athenæum*, as well as to the local press, by Mr Hodder M. Westropp, and again by Mr. Cornelius Nicholson, F.S.A., of Ventnor. A communication on the same subject, by the Rev. S. M. Mayhew, F.S.A., was printed in the Journal of the British Archæological Association,* and another by Mr. C. Roach Smith, F.S.A., in his *Collectanea Antiqua*.† It was subsequently suggested that, in order thoroughly to explore and ascertain the full extent and nature of the buildings, excavations should be started on the adjoining land, the property of Lady Oglander. Upon the introduction of our colleague, Mr. Roach Smith, himself a native of the Island, and his relative Mr. F. Roach, of Arreton, Lady Oglander most kindly accorded the permission required. The co-operation was also obtained of Mr. Micah Cooper, the present tenant, and the work commenced in August, 1880, continuing with brief interruptions up to the present time.‡

In the accompanying plan (see Illustration No. 7) we have been enabled to include all the apartments cleared. The rooms numbered I to V, together with parts of VI, VII and

* Vol. xxxvi. † Vol. vii., p. 237.

‡ September, 1881. It should be borne in mind that since the reading of the original Report of the Brading Villa Executive Committee, on the 13th December, 1880, several fresh discoveries have been made, and a description of them has been incorporated in this Paper. The plan published in No. VI. of the PROCEEDINGS, 1880-81, shows the remains as excavated at the close of last year. The plan (No. 7) opposite includes all the remains of walls and pavements yet discovered.

VIII, are upon the property of Mrs. Munns, and are divided from that of Lady Oglander by a hedge; these were excavated by Captain Thorp, in April, 1880, and we are indebted to him for the list of antiquities then discovered.*

CHAMBER No. I.—This measures 18 feet by 10 feet 6 inches; the walls on the outside are here 27 inches in thickness, the division walls between rooms No. II and No. IV are 18 inches. There are five flue-tiles *in situ* in this chamber, arranged on the east and south walls; the first one is 5 feet 3 inches from the north-eastern corner; at 5 feet 3 inches from the first is another; the next is 6 feet distant; the next 4 feet, and the last 4 feet 6 inches. Their presence indicates the use of the hypocaust, but though the floor line has been discerned, excavation has not yet revealed any traces of columns, or the usual suspended floor. These tiles are 16 inches high and 4 inches broad. In the north-western corner, at 2 feet 6 inches from the wall, are the remains of an arch, composed of flat tiles, and the entrance is 2 feet in width. There is no pavement in this apartment. In this chamber were found the following articles: fragments of black pottery of New Forest ware; many broken flue-tiles; pieces of charcoal in considerable quantity; some faced stones, some in the form of archstones; iron spikes and small nails, some doubled up, probably used for fastening on the roofing-slabs; roofing-slabs made of Bembridge stone, with nails in them; portions of stags' horns and the bones of various domestic animals, principally those of the pig and ox, were also found. The flue-tiles found here were mostly of the same size, some varying slightly; they are all ornamented or scored upon the exterior with deeply-incised markings, some representing waved lines, done apparently by drawing a strong comb across them, others having cross patterns, stars, &c. In other places, such as London and Wroxeter, some highly ornamental specimens have been found. One found in Cannon Street (London), and now in the Walker-Baily collection, was richly ornamented in a pattern twice repeated, as though done with a roller. In Essex and Surrey, specimens having dogs and stags, with foliage and letters which are usually the initials of the maker, have been met with; at Plaxtol, in Kent, some with the name "Cambriabantus" repeated over the whole side. Notwithstanding the ornate character of these tiles, they are generally supposed to have been covered with mortar, and the scoring was simply done for causing the mortar to adhere. These tiles, which are hollow, were used for conveying the hot air from the hypocaust into the chamber above; but they have been also used for supports to a floor, as was seen in a hypocaust discovered at Cirencester (Corinium). Some of these flue-tiles have square holes on one side for the admittance of hot air or smoke from the hypocaust. In a bath at the Roman villa at Hartlip, in Kent, a row of such flue-tiles was discovered forming a seat, extending the whole length of the bath; the tiles were coated over with plaster.

CHAMBER No. II.—This is square, measuring 20 feet, paved with grey marl tesseræ, and the walls are two feet thick. There is evidence of a large fire in the centre of this pavement. Much charcoal was picked up; a coin (unidentifiable); small portions of Samian pottery black and Caistor ware; bones, including portion of a human skull; iron nails, both large and small, and some faced stones.

CHAMBER No. III.—This measures 15 feet 6 inches by 17 feet 6 inches; the ornamental

* A popular Guide-book (illustrated), prepared by the authors of this Paper, is sold on the ground for a shilling, and it has already reached five editions.

centre is 9 feet 6 inches by 10 feet 6 inches, and the margins of the pavement are checkered. In this room were broken fragments of plaster, with fresco, bones, iron nails, pieces of black pottery, Samian, broken flue-tiles, broken stags' horns, and two coins. Fully 20 feet of the wall on the north-east corner are wanting. The pavement in this room is square. On the western side are two gladiators, the Secutor, or one with a trident, and the Retiarius enveloping the other with a net, in combat. On the north side is a fox under a tree. A building with a cupola completes this. On the south side, in front of a pair of steps, is a man with the head and legs of a cock, on his right hand are two griffins, called by some winged panthers. In the centre is the head of Bacchus, or of a Bacchante, and occupying two of the angles are like figures, holding in their hands a staff with a cross upon the top, similar to those held by the nymphs on the Pitney pavement. In these groups, upon which so many opinions have been expressed, there is much that will repay careful study and investigation. The grotesque figure is as yet not clearly understood; various theories have been suggested, but it will probably be proved that this quaint composition is to be associated with the worship of Mithra the sun-god of Persia, as it is in keeping with the semi-oriental character of the designs throughout. Mithraism was a form of superstitious worship professing to reveal to those initiated the secrets of Providence and the hidden processes of Nature; introduced from the East, the mithraic myth spread rapidly in the early days of the Empire, increasing in popularity to the middle of the fourth century, till with the advancement of Christianity it gradually died out, its survival being traced in what is known as the gnostic heresy. There were many sects, who, while adopting Christianity, continued to associate therewith curious doctrines and superstitions imported from the East. Mithra ultimately became identified with Abrasax, an emblem of the gnostics. The cock often appears as an emblem among the mithraic signs. Abrasax also, on gems and other relics, is often represented in human form, but with the head of a cock, the combination of the bird being an emblem of foresight and vigilance. Mr. Roach Smith is inclined to associate the group with the figure of Anubis, but as this god is always represented, by the Egyptians, with a jackal's head,* we fail to see the resemblance. Mr. Roach Smith, however, cites a coin of Tetricus,† upon which the figure of Anubis appears, and remarks that Egyptian mythology had penetrated into the northern provinces of the Empire, and that Postumus, of Gaul and Britain, adopted Serapis as his *comes*. Another solution has been suggested by Professor Lanzone of Turin, who states that this group may be an illustration of an ancient fable. There is certainly a well known one, in Æsop, of the Cock and Fox, with which both the opposite panels may be connected. A further ingenious explanation reaches us from the learned antiquary Signor Lanciani, of Rome. In a private letter he remarks that the quaint composition is Ædipus questioning the Sphinx, who stands on a rock near its side.

Chamber No. IV.—This, from the entrance to the arch on the south, to the pier on the north, side, is 11 feet 8 inches by 10 feet 6 inches, in width. There was no pavement in this room, but at the entrance to the arch a mass of plaster material, similar to that which the tesseræ are laid in, was found; when rubbed between the fingers it was quite soft, becoming

* See Wilkinson's *Ancient Egyptians*, new edition by Dr. Birch, vol. iii., page 159. The jackal-headed god of the Egyptians was ignorantly described and depicted by the Greeks and Romans, as possessing a dog's head.

† See the *Collectanea Antiqua*, vol. v., p. 246.

REMAINS OF ROMAN BUILDINGS NEAR BRADING, ISLE OF WIGHT. (No. 8)

J. P. Emslie, del.

J. P. & W. R. Emslie, lith.

0 1" 2" 3" 4" 5" 6" 1 2 3 4 5 feet

PAVEMENT IN CHAMBER III.

hard upon exposure to the atmosphere. In the north corner of this room is a pier of masonry 2 feet square, and 2 feet 6 inches high; upon the top of this, the base of a column of sandstone was found, and it is in the possession of Captain Thorp. There was in all probability a corresponding pier or pillar to the north of this one, but owing to the existence of the hedge and bank we have as yet been unable to look for it. This was clearly an entrance, as there are indications of steps. Bones, stags' horns (fragments), a quantity of pieces of black pottery, flue-tiles, an iron hinge, a small iron lamp-hook, an iron spike, a large number of stone roofing-slabs, and vitrified stones were here found. Upon the outside of this western wall the trowel marks of the masons are as distinct as though they were only recently done.

CHAMBER No. V.—This is long and narrow, measuring 7 feet 6 inches in width by 20 feet in length, paved with inch grey marl tesseræ. This chamber communicates with No. VI by means of a passage at the east end, 4 feet 9 inches wide. The walls are about 18 inches in width. Many fragments of wall plaster with fresco were dug out of this chamber; also the upper portion of a small jug of Caistor ware, measuring 3 feet high by 3 feet 3 inches in the widest part, having a brownish colour upon it, ornamented with figures in white paint arranged on the sides. A small iron hook or pruning knife; small pieces of glass, faced stones, a broken stone door-jamb, a knife blade, bones of animals, fragments of human bones, tines of stags' horns, goat's skull, boar's tusk and horns of *bos longifrons.*

CHAMBER No. VI.—This appears to be one long apartment, because the length, from the border of the pavement described in Chamber No. III to the margin of the representation of Orpheus, corresponds with the length of the other side of this mosaic to the wall of the Medusa Chamber; these dimensions are 21 feet 10 inches respectively. The representation of the Orpheus floor is 7 feet 6 inches wide by 8 feet 6 inches broad, with a border of the guilloche pattern, one foot wide. Orpheus is here seen playing on his lyre, wearing the Phrygian cap and flowing *pallium* or cloak, as he is usually represented; attracted by his music are animals and birds, suggesting those fine examples at Woodchester, at Winterton and Horkstow-on-Humber, at Littlecote in Wiltshire, and at Saltford, between Bath and Bristol. The peculiarity of this pavement is the figure of a monkey placed near to the left shoulder of Orpheus, and this monkey wears a red cap; the other animals which form part of this design are a coote, a fox and a peacock. The manner in which they are grouped differs in some respects from the well-known example at Cirencester, and that discovered at Woodchester. In the present instance, the animals' attention appears riveted upon the player, whereas, in the large group at Woodchester, they are marching round in procession, and apparently beating time to the music. In the group at Littlecote, Orpheus is the central figure, but upon the animals by which he is surrounded are female figures typifying the seasons of the year; the remainder is paved in large red and white tesseræ, and in a chequered pattern. Such a representation of Orpheus was one especially favoured by the early Christians—indeed, it has been clearly shown that they frequently selected the divinities of antiquity as creations familiar to the popular mind, and in the figure of Orpheus a convenient type existed for the illustration of the Good Shepherd and of other symbols associated with Christianity.* Upon the ceiling of a chamber, in the catacombs of St. Domitilla at Rome, is a

* The late M. Viollet-le-Duc refers to this fact, and illustrates it, in his *Dictionnaire de l'Architecture Française* (Vol. viii., page 498), under the head of "*Symbole.*"

painting, the central design of which is Orpheus playing on the lyre, surrounded by animals; his dress, position, and the general treatment of the subject, forcibly remind us of the pavement at Morton. Occupying the central compartment, he is surrounded by groups such as the raising of Lazarus, Daniel and the Lions, Moses striking the Rock, and other scriptural subjects. But the adaptation of such a design to the purposes of Christian art is more strikingly illustrated by a representation to be seen in the catacombs of Callixtus. Upon a painting there, is a figure of Orpheus of the usual conventional type, but in place of the miscellaneous group of animals he is seen between two sheep only, typifying thereby to the Christian mind the Good Shepherd of the Gospels. In the relations which exist between early Christian and Pagan art the Cavaliere de Rossi discerns a strong connection between figures of Orpheus and the adoption of Christianity. He says that Eusebius and St. Augustine speak of him much in the same way as they speak of the Sibyls, as though he had made some sort of prophetic manifestation of the true God among the Gentiles. It is remarkable that when Alexander Severus placed pictures of Abraham and of Christ in his Lararium, he included that of Orpheus also. His story enjoyed great popularity in the early ages of the Church; both in the East and West his figure is often repeated on medals of Antoninus Pius and Marcus Aurelius, which were struck at Alexandria. In an interesting collection of finger rings, Mr. C. D. E. Fortnum, F.S.A., has brought together some valuable gems of the early Christian period. On many the subjects clearly point to the new religion, on others the intention is not so marked. Among the latter, however, we note a representation of Orpheus charming the animals with his music. It appears upon a bronze ring (see woodcut),* which is

preserved in the Dressel collection at Rome. Mr. Fortnum assigns it to the latter half of the fourth century. The figure is seated, fully draped, and holding in the left hand a lyre which he is playing with the right. An ill-defined covering, probably the Phrygian cap, protects the head; in the field, just above the left shoulder, is a six-pointed star, and upon the right is a monkey, the position being treated much in the same way as on the mosaic at Morton. There is also a lion, and a bull or goat, and in the left a reptile or fish, and a hare or rabbit. While the general arrangement is such as we meet with on Pagan gems, the presence of the star suggests a Christian significance. Beneath this pavement† is a subway which had been covered with flat slabs of native tertiary limestone. This is 6 feet 8 inches long by 2 feet wide and 3 feet 2 inches deep; the stones forming it are of various dimensions but correspond in thickness, which is 8 inches. This subway has evidently something to do with the heating-apparatus for the flues for No. IX and No. XII, as both these chambers have suspended floors. It contained a great quantity of fragments of stone, pottery, &c., all bearing marks of fire, and amongst the débris a third brass of Constans, was found. The greater part of the wall on the eastern side of this chamber is wanting, and on the western side it is composed of rubble and irregularly-sized stones; just above the floor line is a string-course of stone slabs, instead of the well-known bonding-tiles.

* We are indebted to the Council of the Royal Archæological Institute for the loan of Mr. Fortnum's illustration.

† See, for information, collected from various sources, concerning Roman pavements and hypocausts discovered in different parts of England, *A description of the Roman Tessellated Pavement found in Bucklersbury*, by John E. Price, Nichols & Son, Westminster, 1870. 4to.

REMAINS OF ROMAN BUILDINGS NEAR BRADING, ISLE OF WIGHT. (Nº 9)

J.P.Emslie, del.

J.P.& W.R.Emslie, lith.

0 1" 2" 3" 4" 5" 6" 1 2 3 4 5 feet

PAVEMENT IN CHAMBER VI.

During the excavation of this chamber a considerable quantity of pottery, mostly coarse, of the make known as Upchurch ware, was collected, but not sufficient to make up any vessel; some pieces of a fine red ware, a sort of pseudo-samian, ornamented with incised figures of crescents, &c. (see illustration No. 11, fig. xix.), of precisely the same kind as has been met with in Barge Yard (London), Wroxeter and Richborough, but this pattern is of considerable rarity, and was probably made in Britain. No perfect vase of the make is known to exist. A considerable quantity of this pseudo-samian ware was found at Cirencester. Another piece of pottery, of rare ornamentation, was found here; the paste is red, with black glaze, with three or four furrows, and the body of the vessel is ornamented with small diamond-shaped figures, stamped in the paste before firing. The figures are one-third of an inch high by a quarter of an inch wide. (See illustration No. 11, fig. xviii.) Upon the Orpheus pavement a small bronze chain, part of a bronze armlet or bracelet of usual type, some fragments of thin green glass, a quantity of bones of pig and ox, and further northwards small portions of a human skull (which pieces have been unfortunately mislaid), a portion of a human fibula, part of a human jawbone (which latter bones the late Professor Rolleston stated not only belonged to an old man, but to a very big one), as well as some flint flakes, were found; this latter find seems to indicate that the Romans made use of native labour in the island, as they did elsewhere and as we do in our own colonies, and whilst they used bronze and even iron, the Britons also made use of their native implements. Two large flint balls, similar to those we found in the Roman cemetery at Seaford, Sussex,* and two small stones, almost spherical, were likewise picked up in this corridor. It occurred to us that they, being so much like marbles, might have been used for a game. Stone balls were also found at Watermoor, near Cirencester, and have usually been considered as catapult or sling stones; but Dr. Church thinks, from circumstances attending the finds at Pompeii, that these stones were probably used in a game of ball. A curious object in bone, 1¾ inches in length, was dug out here; it is in the shape of a diamond, polished upon the upper surface and rough beneath, with a ring stamped out in the centre. (See illustration No. 11, fig. iv.) Three articles of like form were found at Lydney Park, in the Roman remains there excavated by Mr. Bathurst, who has described them as being "ornamental plaques, to be applied to leather;" this may be the case, but we are rather inclined to think this object was intended for a domino, or to serve for some other game. A round counter three-quarters of an inch in diameter, a small ring in bone and some iron nails, were here met with. The earth was very black in this part. In this room and in No. VII, were found a number of pieces of a large vessel (see illustration No. 11, fig. i.), made of what resembles Portland cement, nearly three-quarters of an inch in thickness, the inside being marked with the impress of the potter's fingers or thumbs all over: it was probably a mortarium. We have submitted these interesting fragments to Mr. John Phillips, a well-known potter of Devonshire, who has kindly favoured us with his opinion.† The following

* See *Notes on the Romano-British Cemetery at Seaford, Sussex*, by Mr. F. G. Hilton Price and Mr. John E. Price, in the Journal of the Anthropological Institute of Great Britain and Ireland, vol. vi.

† Mr. John Phillips, writing from Newton Abbott on the 18th June, 1881, says:—"While I am quite clear that the segment of the vase found at Brading, which displays the exceptional finger markings on the inner surface, is made of what is now known as Portland cement, I have been unable in the experiments which I have made to obtain in one respect a *perfect* reproduction. In general aspect and character the facsimile was good, but the rim or bead on the Brading vase displays evidence of being turned down. This

coins were found upon the Orpheus pavement: two third brass of Victorinus; five minimi of Gaulish type of Tetricus; a third brass of Gallienus; a silver or billon coin of Salonina, his wife; and a third brass of Constans. On the south side of the same pavement, a horse's bit in iron was found, 4 inches in length, the cheek rings being wanting. Several fragments of flue-tiles were collected in clearing out this chamber, likewise shells of oysters, limpets, cockles, snails, &c., and parts of the antlers of red deer. Some large faced stones, a bronze hair-pin, part of a bronze earring, and a bone reel, 3 inches high by 1 inch broad, were found on the south side of the Orpheus pavement. Interesting pieces of plaster with fresco upon them were picked up on the same side of this chamber, one piece 11 inches long by 6 inches, representing a group of fruit in a circular medallion on straw-coloured ground; another having a handsomely coloured bird of the parrot family, 10½ inches long, with a margin of broad red and white stripes 4 inches broad; also a piece of the tine of a stag's horn, 3¾ inches in length, having a pig's tooth inserted in the centre. The horn has been faced with a knife seven times, and is hollow; it was found by Captain Thorp upon the checkered pavement.

Chamber No. VII.—This is intersected by the boundary hedge dividing Lady Oglander's property from that of Mrs. Munns; it is 20 feet square, and the entrance to it was evidently out of No. IV. It is paved in squares of red and white inch-tesseræ, which are much injured by fire, especially in the east end of the room. Very little of interest was found here, beyond a few pieces of flue-tiles, bones of pig, ox and deer, and shells of oysters, cockle and snail. The wall dividing it from No. IX was much decayed, the mortar being quite rotten, but the marks of the foundation are plainly visible.

Chamber No. VIII.—This is apparently a square, measuring 20 feet by 21 feet (but it is difficult to obtain exact dimensions, owing to the hedge), containing neither tesseræ nor concrete floor; near the hedge or boundary line is a circular structure, 4 feet 6 inches in diameter, formed of Bembridge stone rubble, and lined inside with a coating of the salmon-coloured mortar. At the bottom are marked indications of fire, in such quantity as to suggest that the place was used as a furnace or oven for smelting or baking. We have not been able to explore the whole of this structure, as it runs beneath the bank and hedge. The boundary wall on the west side is here nearly 3 feet in thickness, a circumstance which leads us to the opinion

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is very clearly shown in the *section* of the bead, where layers appear one over the other, falling back from the inner surface and turned over the outer surface. I have failed in every attempt to produce this effect in any legitimate manner as essential to construction. It cannot be produced in modern Portland cement; therefore, the makers of this vase either had some ingredient which they mixed with the cement or it possessed properties which are unknown in modern cement. From personal observation at Brading, I was of opinion that Purbeck marble had been used in the structure of the villa. If this be allowed, then it is quite conceivable that when the builders of this villa went to Swanage for the marble they would observe the character of the lime there used, which is a natural cement, and *now* known in the building trade as Portland cement; and we can well conceive that such careful builders as were these early masons would readily comprehend and appreciate the qualities of this hydraulic lime, though we must allow it remains that they did not use it *throughout* their work. This view appears to me more probable than that artificial Portland was *manufactured* in those early days. In discussing this matter it may be suggestive to some minds—though I cannot myself see the application—to mention that in certain pottery processes, where great tenuity is required in the clay, it is largely mixed with *gum*, and can then be manipulated and formed into a hundred shapes, which it could not otherwise be made to assume. So far as my experiments have gone, cement cannot thus be treated. Hence the formation of the rim of this vase is to me inexplicable; while I still maintain that this fragment is a portion of a vase made of cement such as that which we now style Portland cement."

that it may have been an external wall, as its width is so much greater than other walls of the building. The earth on the outside of this wall has not yet been cleared away. There is an opening into No. X, 3 feet 6 inches wide.

CHAMBER No. IX.—This is 19 feet 9 inches square; the bordering of the pavement is composed of the usual red and white inch-tesseræ, and in the centre is a square measuring 5 feet 10 inches, inclosing a diamond or lozenge-shaped figure, with a central medallion of parti-coloured tesseræ. On the north side of the room were two or three squared blocks of stone, which probably supported the wooden uprights for carrying the roof. Several pieces of roof-slabs, some having the iron nails still *in situ* in them, a quantity of fragments of worked stone, nails, pieces of pottery and animal bones were met with. An iron object much like a strigil was found upon the floor of this room, measuring 8½ inches in length. There is a good deal of plaster or stucco still standing upon the walls to the north and west, displaying scroll patterns of dull colours much faded.

CHAMBER No. X.—This measures 11 feet 6 inches by 10 feet 5 inches; the walls are 1 foot 9 inches in thickness. It has a raised ledge or seat on the west side, 6 inches high by 1 foot wide, covered over with red plaster, and on the north side is another similar ledge 2 feet 6 inches wide. Upon the floor were, *in situ*, a large number of flat red tiles, 14½ inches by 11¾ inches, corresponding with the dimensions given by Vitruvius and Pliny. There was not any plaster nor were there any tesseræ upon this floor, so we suppose it must have been originally wholly paved with red tiles. Several pieces of coarse black pottery, the base of an earthenware strainer,* some roof-tiles, and iron nails belonging to them, were all this room yielded, excepting several fragments of sandstone coated over with a green vitreous glaze, indicating that either the fusion of glass objects had so covered the stones, or that it was slag from a glass furnace.

CHAMBER No. XI.—This is 15 feet by 5 feet; the walls are from 18 inches to 21 inches high, and the chamber is paved with rough concrete. No objects of any interest were here discovered.

CHAMBER No. XII.—The dimensions of this, from east to west, are 39 feet 6 inches by 19 feet in the western portion, 15 feet 6 inches in the eastern portion, and 11 feet between the piers in the centre. The pavements are remarkable. At the west end the mosaic pavement is almost square, its dimensions being 13 feet 6 inches by 13 feet 10 inches, divided into compartments, all edged with the guilloche border in half-inch-tesseræ of white, black and red. The design may be described as in three divisions with a central circular medallion, also bordered by the guilloche, but the subject is destroyed; sufficient, however, remains to show that it contained a similar little house to that already mentioned in Chamber No III. Upon either side are oblong panels containing mythological subjects, and at the corners are semicircles inclosed in compartments; these are occupied, with the exception of one which has perished, by busts in illustration of the Four Seasons, the missing one, from the north-west corner, having probably represented Spring. Summer appears at the south-west corner, and is tolerably well preserved; the head is that of a female whose hair is decked with poppies. Above a semicircle of guilloche pattern there is in the angle of this compartment a figure of a peacock with flowing tail, represented pecking at flowers in a vase; the plumage of the bird is worked in many colours. There are also traces of a bird in the injured composition supposed to contain Spring. It is therefore probable that there were figures of birds in each compartment

* Colanders in earthenware are of rare occurrence; some were, however, found at Cirencester.

suitable to the season of the year. Autumn is also a female figure, treated in a similar manner to the former, her hair ornamented with ears of corn in illustration of Ceres, wearing a torque round her neck, suggestive of a similar subject discovered on the mosaic pavement from Carthage,* now in the British Museum, and in our own country at Cirencester, the Roman Corinium. The last, Winter, is the most perfect of all; this is also a female figure, closely wrapped, her garment being fastened across the left shoulder by a brooch or *fibula,* and attached to the dress is a *cucullus* or hood, which could be drawn up over the head in rough weather, similar to that worn by ecclesiastics at the present time. In the left hand she carries a leafless bough, from which is suspended a dead bird. An example treated in a like manner was found in the Roman Villa at Bignor, and illustrations of the Seasons have likewise been found on mosaic pavements at Thruxton, Frampton, Littlecote Park and Cirencester. The subject was a favourite one with the Romans; apart from its treatment in mosaic, it has been adopted upon coins, and for the ornamentation of objects in domestic use. On the Imperial coins inscribed TEMPORVM FELICITAS they appear as four boys occupied in dancing. Upon a silver *situla* or bucket discovered at Tourdan, near Vienne, in the south of France, and now in the British Museum, this design is the principal one employed. Spring is represented by the nude figure of a female, crowned with flowers, and seated on a panther; she bears a basket of flowers and is surrounded by cupids. Summer is seated on a bull reposing on the ground, she holds a sheaf of corn and is accompanied by a cupid carrying a sickle. Autumn is a female crowned with grapes, and seated on a panther; she is preceded by a cupid bearing a basket of fruit, and followed by another who is holding the panther's tail. Winter is personified by an aged female seated on a boar; among the cupids which follow is one muffled and carrying dead game. Upon another portion of this *situla* is a combination still further suggestive of the Morton mosaic, namely, a group of sea monsters with heads of lions, horses, &c. ridden by cupids and other figures. The centre of our pavement is much injured, but the central design was evidently contained in a circular medallion bordered with the guilloche pattern. Around the medallion were four oblong panels placed between the angles containing the Seasons. These probably represented mythological subjects, because in the one which is tolerably well preserved appear figures which may be recognized as Perseus and Andromeda. The scene as represented is after the liberation of the girl, when she and her preserver are seated on the sea shore. The male figure holds aloft in his right hand the Gorgon's head, and Andromeda looks at its image reflected on the waters, for had she looked directly at the monster she would have been petrified at once. In the left hand of Perseus appears the weapon with which the head was severed. The representation of the shore is worked in dark brown and other coloured tesseræ, indicating rocks. At the feet of the figures are apparent indications of the monster associated with the myth. This panel is, as were doubtless all the others, bordered with the guilloche pattern. Between the two stone piers already named and dividing the two pavements of this apartment, is a subject of considerable interest: in the centre is a square panel containing a male figure, wearing a black beard, seated in what appears to be a chair; he is semi-nude, there being but little drapery except at the lower portion of the figure. At his left side stands a pillar, surmounted by what is thought to be a gnomon or sun-dial, but which we ourselves believe to be an illustration of the twelve houses, the number of the compartments

* See *Carthage and her Remains* (page 191), by Dr. N. Davis. London, 1861. 8vo.

corresponding with the signs of the Zodiac. It bears, however, a striking resemblance to the Solarium or quadrant lately found at Tusculum. Beneath the pillar is a *sphæra* or globe which appears to be supported on three legs, similar to those in the painting representing a like object lately discovered in the Palatine at Rome. The tesseræ are so arranged as to define the four quarters of the world, and to this globe the figure is pointing with a wand as though casting a horoscope; at his right hand is a cup or vase, in which is an object considered by some to be a pen, but this is not identified with certainty. This illustration of an astronomer in the exercise of his profession is one of the most interesting of the novelties yet revealed; the figure is probably intended for Hipparchus, a celebrated student of antiquity—he who, it is said, was the first to prosecute the science in a regular and systematic manner. His observations were made between the years 160 and 125 B.C. His catalogue of the fixed stars has been preserved by Ptolemy, and one work, the only one extant, is his commentary on Aratus, for which according to Pliny he could never be sufficiently commended; he had proved the relation of the stars to men, he attempted to express such relation by appropriate names, and devized instruments by which he might mark the places and the magnitudes of each particular star. The nature of these instruments has never been ascertained, but there is nothing improbable in the notion that those shown in our mosaic are those which are associated with his discoveries. On each side of this panel is a geometrical pattern, composed of a centre with a circle, from which radiate four divisions inclosed within a larger circle; this is again placed in a diamond or lozenge-shaped figure, the whole being contained in a parallelogram, in the angles of which are figures of triangles; the border, as in other cases, consists of the guilloche pattern. These designs are similar to those figured by Mr. H. Ecroyd Smith in his description of the pavements at Aldborough, the Roman station of Isurium. The eastern division of this chamber contains the largest and most important of the mosaics yet found. In the centre is a large medallion containing the head of Medusa, such as occurs both at Bignor and Bramdean; in position it is slightly orientated. Springing from this centre are four compartments, arranged crosswise as shown upon the plan; each of these is bordered by the guilloche pattern; at the angles north, south, east and west are triangular compartments which contain bucolic figures blowing the *buccina* or neat-herd's horn; on their heads is the *petasus* of Mercury, and over their left shoulder is a *pallium* or cloak. The designs which make up the four panels referred to are of great interest, each containing two figures of male and female; the subjects appear to be of a pastoral character, as evidenced both by the costume and the objects borne by each figure. The interpretation of the subjects is uncertain. A selection is, however, made for present illustration (see woodcut). It represents a group in the south-west compartment of the lower portion of the pavement, worked in small tesseræ of varied colours.

A female figure, partially draped after the manner of the *Saltatrix* or dancing girl of Greece and Italy, is remarkable, and the musical instrument, upon which she is playing with the right hand, is suggestive of some of the Pompeian paintings, which illustrate the female player of the *tympanum* or tambourine. Her companion is a male figure of more than ordinary interest, on account of the peculiarities presented by the costume worn, for he wears a Phrygian cap, a skirted tunic with a small cloak or *pallium* fastened on the right shoulder, and what is very unusual with such figures he appears with *braccæ* or trousers, which are loose and plainly distinct above the ankle, and *calceus* or the boot or shoe beneath. The peculiarity of this dress leads to the opinion that it may be that in fashion at the time the mosaic was laid down, because the form given to the *braccæ* is different to that usually met with in the costume attributed to the "barbarians" or the provincials in Roman sculptures. The Pandean pipe, a musical instrument formed from stalks of reed or cane, which is held in the right hand by the figure, and the presence of the shepherd's crook, denote the pastoral meaning of the group. A second panel comprizes a design, the meaning of which is at once intelligible: a female figure, tall and closely draped, is seen bearing in one hand a staff, and in the other ears of corn, which she is presenting to a man, who, though perfectly nude, holds by the left hand the *bura* or *buris*, namely, the hinder part of the ancient plough. The subject is clearly that of Ceres offering the fruits of the earth to Triptolemus, who, according to the stories of mythology, was the inventor of the plough and agriculture. In the Georgics of Virgil we read how Ceres first taught humanity to plough the land with iron, and again,

> "*Prima Ceres ferro mortalis vertere terram**
> *Instituit:*"

how the sower was both to plough and sow naked,

> "*Nudus ara, sere nudus: hiems ignava colono.*" †

Another panel contains what, as suggested by Signor Lanciani, may be a representation of Lycurgus, King of Thrace, persecuting a bacchante, a follower of that god who had introduced into that remote region the cultivation of vines; he had suffered severely from Lycurgus for the attempt. In the background of the composition, appears a vine-tree or some plant representing vines. The *bi-pennis* or double-edged axe, borne by the male figure, is a distinctive symbol of the Thracian king—"*bipenniferumque Lycurgum*" of Ovid.‡ The fourth panel is much injured, and the figure difficult to identify. The whole of this chamber is bordered with red inch-tesseræ, that portion in the western division containing a fret pattern laid in white, terminating at the head of the chamber in a figure of the *Svastika* § or vedic cross. The presence of this symbol has been noted before upon remains of Roman buildings discovered in this country. As a religious emblem, it is probably the most ancient symbol extant, and it has been cited as a gnostic symbol derived by the early Christians from Oriental creeds. With the Buddhists it was viewed as an emblem of resignation, and appears upon the sacred relics of the Vaishnavas. It occurs on the oldest Greek coins, on Etruscan vases, and on the Newton stone at Aberdeen, which is a Celtic monument. Dr. Schliemann has noted its presence on pottery

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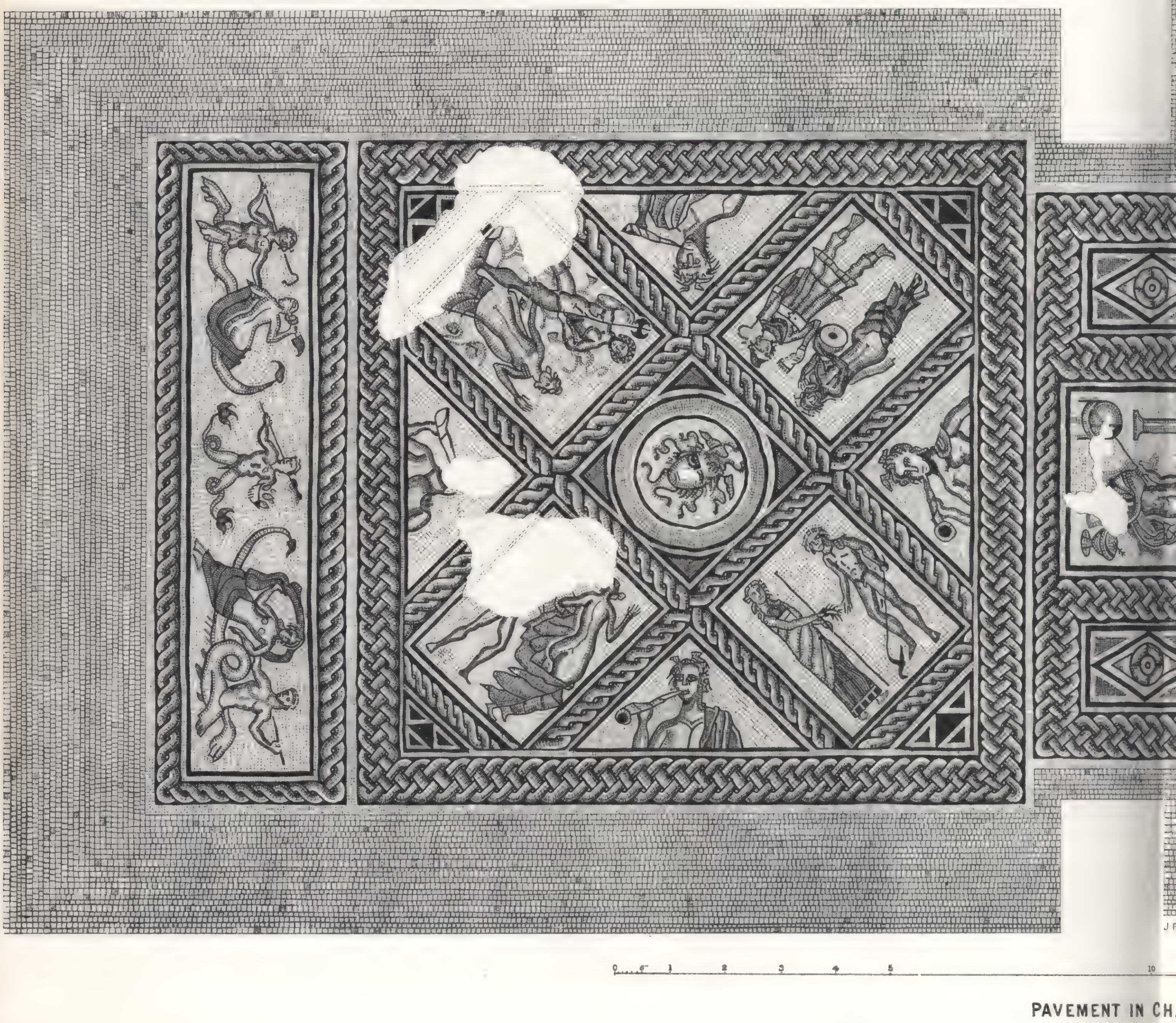
* Georgics lib. i, 147. † Georgics, lib. i, 299. ‡ Met. 4, 22.

§ See, page 157, Mr. John G. Waller's remarks respecting this figure and a quotation from his work on Monumental Brasses.

REMAINS OF ROMAN BUILDINGS NEAR BRADING, ISLE OF WIGHT. (Nº 10)



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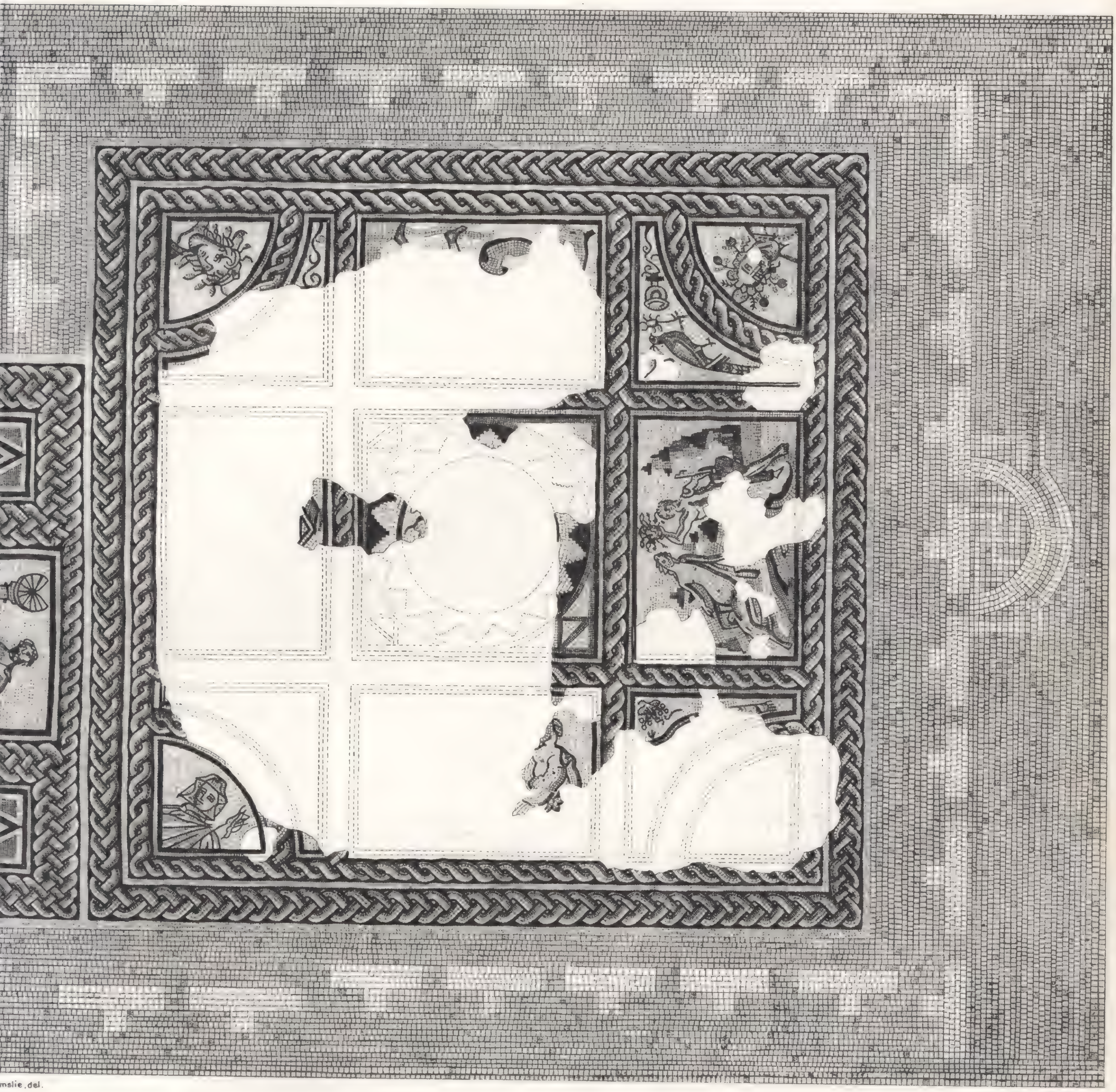

mslie, del.

J.P & W.R Emslie, lith., London.

15 20 feet

MBER XII.

[*Supplement.*]

Royal Institute of British Architects.

INCORPORATED IN THE SEVENTH YEAR OF WILLIAM IV.

Vol. III. N.S., No. 12. SESSION 1886-87. 31 MARCH 1887.

THE NINTH ORDINARY MEETING (BUSINESS) of the Session will be held on Monday Evening, the 18th of April 1887, when the Chair will be taken at Eight o'clock p.m. precisely.

Proceedings.

To read the Minutes of the Ordinary Meeting held on Monday, the 28th March; to formally admit members attending for the first time since their election; and to ballot for the following who desire to be admitted:—

As FELLOWS.

THOMAS TILLMAN, *Associate* - - -	5, Bridge Street, Sunderland.
FREDERICK DUDLEY - - - -	19, Queen Anne's Gate, S.W.
ZEPHANIAH KING, *Associate* - - -	3, Victoria Street, Westminster, S.W.
ROBERT FABIAN RUSSELL - - -	6, Moorgate Street, E.C.

As ASSOCIATES.

NORMAN MICHAEL BROWN - - -	102, Welford Road, Leicester.
THOMAS RIDLEY MILBURN - - -	Roker, Sunderland.
FREDERICK WILLIAM KITE - - -	1, Clevedon Terrace, Rochester.
ARCHIBALD DUNCAN WATSON - - -	16, Rutland Terrace, Stamford.
ARTHUR ERNEST BARNSLEY - - -	6, Ethelbert Road, Bromley, Kent.
ARTHUR COLPOYS WOOD - - -	20, Boscobel Gardens, St. John's Wood, N.W.
JOHN COULSON NICOL - - - -	6, Augusta Rd., Acocks Grn., nr. Birmingham.

AS HON. ASSOCIATE.

LT.-COL. JOHN DAVIS, F.S.A., M.Inst.C.E.-	Bifrons, Farnborough, Hants.

Questions and Motion by Professor KERR, *Fellow*:—

1. To direct attention to the observations made by Mr. Barry and others at the Meeting, on 14th March, upon a question raised by Mr. T. S. Archer, *Fellow*, and to request that the short-hand notes of those observations be read. Then to move—"That "members of the Institute are expected to support the authority of the Schedule of "Charges published by the Institute, as the recognised custom of the profession."

2. To inquire what steps would be taken by the Council upon their receiving a complaint touching the honour of one or more leading members of their own body with reference to personal conduct in connection with a case of disputed professional charges; and more particularly whether the Council, if they were to appoint a Committee of their own body to deal therewith, in accordance with the By-law, would allow the parties to be consulted upon the nomination of such Committee?

THE NEW BY-LAWS.—Members are invited to favour the Council with suggestions for altering or amending the existing By-laws relating to (*a*) The conditions of membership, and the privileges, obligations, and benefits

of the several classes of members; (*b*) The cases in which a member may be expelled or suspended from membership; (*c*) The mode of voting at meetings, whether in person, or by proxy, or by ballot, or by voting papers, or otherwise. The existing By-laws, to which the attention of members is specially directed, are XVIII, XXIII, and XXIV; and also the Forms of Declaration, A. and B. (printed in the last issue of this Supplement, page 24 *ante*).

The Architects' Benevolent Society.

CONTRIBUTIONS FOR THE YEAR ENDED 31ST DECEMBER 1886.

Adams: Cole A., 14, Holden Terrace, Grosvenor Gardens, S.W.	1	1	0
Aitchison: George, A.R.A., 150, Harley St., W.	1	1	0
Anderson: J. Macvicar, 6, Stratton St., W.	27	2	0
Anderson: R. Rowand, LL.D., 24, Hill St., Edinburgh	1	1	0
Appleton: Edward, 1, Vaughan Parade, Torquay	1	1	0
Archer: T. Searancke, 2, Gresham Blds., E.C.	1	1	0
ARCHITECTURAL ASSOCIATION, 9, Conduit St., W.	10	10	0
Ashbridge: Arthur, 76, Leadenhall St., E.C.	1	1	0
Ashlin: G. C., 1, College Street, Dublin	1	1	0
Barry: Charles, F.S.A., 1, Westminster Chambers, Victoria Street, S.W.	1	1	0
Bartleet: W. G., 2, New Broad Street, E.C.	1	1	0
Batterbury & Huxley: Messrs., 29, John St., Bedford Row, W.C.	2	2	0
Bassett-Smith: W., Drummond Chambers, 10, John Street, Adelphi, W.C.	2	2	0
Baxter: R. C., Hethersett, Reigate	2	2	0
Beaumont: J. W., 21, Cannon Street, Manchester	1	1	0
Bell: Charles, 9, New Broad Street, E.C.	1	1	0
Blaber: C. O., 64, Ship Street, Brighton	1	1	0
Blomfield: A. W., M.A., F.S.A., 6, Montagu Place, W.	21	17	0
Boardman: Edward, Norwich	1	1	0
Botterill: W., 23, Parliament Street, Hull	1	1	0
Boulnois: W. A., 6, Waterloo Place, S.W.	5	5	0
Brandon: David, F.S.A., 24, Berkeley Sq., W.	2	2	0
Brereton: F. S., 292, High Holborn, W.C.	1	1	0
Brock: E.P.Loftus, 19, Montague Place, W.C.	1	1	0
Builder: Proprietors of the, 46, Catherine Street, Strand, W.C.	1	1	0
Burnell: E. H., 32, Bedford Row, W.C.	1	1	0
Byrne: W. H., 20, Suffolk Street, Dublin	1	1	0
Capes: S. C., 16, Doughty Street, W.C.	1	1	0
Carpenter: R. H., 4, Regent Street, S.W.	2	2	0
Carritt & Monier-Williams: Messrs., 18 & 19, Great St. Helens, E.C.	1	1	0
Cates: Arthur, 7, Whitehall Yard, S.W.	3	3	0
Chadwick & Sons: Messrs. Spencer (1885-86), 17, Parliament Street, S.W.	3	3	0
Charlewood: H. C., 6, John-Dalton Street, Manchester	1	1	0
Chorley: C. Roberts, 15, Park Row, Leeds	1	1	0
Christian: Ewan, 8A, Whitehall Place, S.W.	4	4	0
Christian: J. Henry, 8A, Whitehall Place, S.W.	2	2	0
Christopher: J. T., 16, Bloomsbury Square, W.C.	2	2	0
Clarke: G. Row, 29, Great James St., W.C.	1	1	0
Clemence: J. L., Lowestoft	1	1	0
Clifton: E. N., 7, East India Avenue, E.C.	1	1	0
Clutton: H., Hartswood, Reigate	1	1	0
Collcutt: T. E., 36, Bloomsbury Square, W.C.	1	1	0
Collier: R. W., Woodhatch, Reigate	2	2	0
Colling: J. K., 6, Salisbury St., Strand, W.C.	1	1	0
Collins: H. H., 61, Old Broad St., E.C.	1	1	0
Colyer: F., 19, Great George Street, S.W.	1	1	0
Corser: B., 57, Colmore Row, Birmingham	1	1	0
Crace: J. G., 38, Wigmore Street, W.	1	1	0
Crockett: Edwin A. B., 16, Mark Lane, E.C.	1	0	0
Cundy: T., 82, Cornwall Gardens, Queen's Gate, S.W.	5	5	0
Currey: Henry, 37, Norfolk St., Strand, W.C.	12	2	0
Currey: Percivall, 37, Norfolk Street, Strand, W.C.	1	1	0
Darbyshire: H.A., 4, Trafalgar Square, W.C.	5	0	0
Davis-Colley: A. H., 48, King Street, Manchester	1	1	0
Davy & Sons: Messrs., 137, Long Acre, W.C.	2	2	0
Dawnay: A. D., 28, Queen Street, E.C.	1	1	0
Denny: A., Rockfield, Tramore, Co. Waterford	1	1	0
Devey: George (1885-86), 123, Bond Street, W. (deceased)	2	2	0
Drew: Thos., 6, St. Stephen's Green, Dublin	1	1	0
Drury: E. Dru, 35, Bucklersbury, E.C.	1	1	0
Dunn: A. M., Newcastle-on-Tyne	1	1	0
Dyball: Sextus, 35, Bucklersbury, E.C.	1	1	0
Ebbetts & Cobb: Messrs., Savoy House, 115, Strand, W.C.	1	1	0
Edmeston: James, 42, Old Broad Street, E.C.	1	1	0
Edwards: Francis, 10, John St., Adelphi, W.C.	1	1	0
——— *per* E. H.	1	1	0
Edwards: R. Clarke, 1, Buckland Crescent, Belsize Park, N.W.	2	2	0
Elgood: J. G., 110, King Street, Manchester	1	1	0
Emerson: William, 8, Sanctuary, Westminster, S.W.	10	0	0
Farquhar: Sir W. R., Bart., 18, King Street, St. James's, S.W.	2	2	0
Fawcett: W. M., M.A., 1, Silver St., Cambridge	1	1	0
Fergusson: James, F.R.S. (deceased)	2	2	0
Ferrey: B. Edmund, F.S.A., 15, Spring Gardens, S.W.	1	1	0
Fletcher: Banister, 29, New Bridge St., E.C.	1	1	0
Florence: H. L., 3, Verulam Buildings, Gray's Inn Road, W.C.	2	2	0
Fowler: Charles, 23, Queen Anne Street, W.	2	2	0
Francis: F. J. (1885): 34, Old Broad St., E.C.	1	1	0
Francis: H. (1885): 34, Old Broad St., E.C.	1	1	0
Freeman: H. A., 6, Queen Anne's Gate, S.W.	1	1	0
Gardiner: W. J., 110, Great Russell Street, Bedford Square, W.C.	1	1	0
Garling: H. B., 7, Bedford Row, W.C.	1	1	0

	£	s.	d.
Geoghegan: C., 205, Great Brunswick Street, Dublin	1	1	0
Gibson: John, 13, Great Queen Street, Westminster, S.W.	83	9	0
Godwin; George, F.R.S., 6, Cromwell Place, South Kensington, S.W.	100	0	0
Goodall: A.H., Central Chmbrs., Nottingham	1	1	0
Goodchild & Son: Messrs., 81, Finsbury Pavement, E.C.	1	1	0
Graham: Alexander, Carlton Chambers, 4, Regent Street, S.W.	1	1	0
Gray: J. W., Norbury House, Surbiton	0	10	0
Gregg: Ebenezer, 1A, St. Helen's Place, E.C.	2	2	0
Grellier: W., 17, Abchurch Lane, E.C.	6	6	0
Grimthorpe: Lord, 33, Queen Anne St., W.	1	1	0
Gruning: Edward A., 9, Gresham House, Old Broad Street, E.C.	3	3	0
Gundry: Horace, 8, Radnor Place, Hyde Park, W.	1	1	0
Gwyther: W. W., 43, Lincoln's Inn Fields, W.C.	2	2	0
Grose: Vincent J., Terminus Chambers, 19, Railway Approach, London Bridge, S.E.	1	1	0
Hansard: Octavius, 8, Argyll Place, Regent Street, W.	1	1	0
Hardwick: P. C., F.S.A., 2, Hereford Gardens, Park Lane, W.	1	1	0
Hayward: C. Forster, F.S.A., 47, Museum Street, Bloomsbury, W.C.	1	1	0
Haywood: Lieut.-Col., Guildhall, E.C.	1	1	0
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Hebb: John, Metropolitan Board of Works, Spring Gardens, S.W.	1	1	0
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Hill: Samuel, 233, Camden Road, N.W.	2	2	0
Hine: G. T., 4, Victoria Street, Nottingham	2	2	0
Hine: T. C., 4, Victoria Street, Nottingham	1	1	0
Holden: J.P. (1885 & 1886): 64, Cross Street, Manchester	2	2	0
Holden: John, 64, Cross Street, Manchester	1	1	0
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Hudson: John, 80, Leman Street, E.	1	1	0
Hudson: William, 19, Bennett's Hill, E.C.	1	1	0
Hunt: Fred. W. (1885 & 1886): 27, Upper Baker Street, N.W.	4	4	0
I'Anson: Edward, F.G.S., 7A, Laurence Pountney Hill, E.C.	11	1	0
I'Anson: E.B., M.A., 7A, Laurence Pountney Hill, E.C.	1	1	0
Inskipp: George, 5, Bedford Row, W.C.	1	1	0
Jackson: T. G., M.A., F.S.A., 11, Nottingham Place, W.	1	1	0
James: J. W., 17, Maude Rd., Camberwell, S.E.	1	1	0
Jarvis: H., sen., 29, Trinity Square, Southwark, S.E.	1	1	0
Jarvis: H., jun., 29, Trinity Square, Southwark, S.E.	1	1	0
Jennings: Joseph, 4, Chapel Mews, Langham Street, W.	2	2	0
Johnson: R. J., 3, Arcade, Pilgrim Street, Newcastle-on-Tyne	2	2	0
Jones: Sir Horace, 30, Devonshire Place, W.	2	2	0
Judge: George, 5, Frederick Place, Gray's Inn Road, W.C.	1	1	0
Keirle: R., 111, Victoria Street, S.W.	1	1	0
Kemp: F. Nesbitt, 22, Chancery Lane, W.C.	1	1	0
Kempster: J. F., Ballinasloe, Ireland	2	2	0
Kidner: William, 23, Old Broad Street, E.C.	1	1	0
King: Zephaniah, 3, Victoria Street, S.W.	1	1	0
Knightley: T. E. (1885 & 1886): 106, Cannon Street, E.C.	2	2	0
Law: Edmund, 29, Abington Street, Northampton	1	1	0
Lee: Ernest C., 30, Great James Street, W.C.	1	1	0
Legg: H. Simpson, Architect's Office, Christ's Hospital, E.C.	1	1	0
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Littler: Henry, Bow Chambers, Cross Street, Manchester	1	1	0
Littlewood; Messrs. J. & W. H., Manchester	1	1	0
Lord: Henry, Manchester	1	1	0
Lynam: Charles, Stoke-upon-Trent	1	1	0
Mackinnon: A. K., F.G.S., 1, Gloucester Street, South Belgravia, S.W.	2	2	0
Mair: G. J. J., F.S.A., 41, Upper Bedford Place, W.C.	2	2	0
Martin: William, 106, Coleman Row, Birmingham	1	1	0
Martineau: E. H., 30, Weymouth St., W.	1	1	0
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Maylard: C. G., 21, King William Street, Strand, W.C.	1	1	0
Meakin: W. F., 6, Martin's Lane, E.C.	1	1	0
Mills: Alex. W. (1885 & 1886): 23, Strutt Street, Manchester	2	2	0
Murgatroyd: James, 23, Strutt Street, Manchester	1	1	0
Murray: A.E., 37, Dawson Street, Dublin	1	1	0
Nash: W. Hilton, 5, Adelaide Place, E.C.	1	1	0
Newby: Thomas (1885 & 1886): 57, Market Street, Manchester	2	2	0
Nicholson: Ralph, 55, Parliament St., S.W.	1	1	0
Norton: John, 24, Old Bond Street, W.	1	1	0
Notley: F. C., Oakdene, Mitcham Road, Streatham, S.W.	1	1	0
NOTTINGHAM ARCHITECTURAL ASSOCIATION, Newcastle Chambers, Market Place, Nottingham	5	5	0
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Oliver: Harry, 5, Queen's Gardens, Hyde Park, W.	1	1	0
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Pertwee: Charles, Claremont Villa, Chelmsford, Essex	1	1	0
Petit: Henry, 26, Welbeck Street, Cavendish Square, W.	1	1	0
Phené: J. S., LL.D., F.S.A., F.G.S., 5, Carlton Terrace, Oakley Street, S.W.	1	1	0
Pilkington: A Friend per Rev. J. G.	100	0	0
Pite: A. R., 44, Bloomsbury Square, W.C.	1	1	0

Plummer: Arthur B., 46, Cloth Market, Newcastle-on-Tyne	1	1	0
Porter: F. W., 16, Russell Square, W.C.	18	10	0
Pullan: R. P., 9, Melbury Road, Kensington, W.	3	3	0
Purday: C. H., 8A, Whitehall Place, S.W.	1	1	0
Powell: W. H., 18, Mecklenburgh Sq., W.C.	1	1	0
Raggett: G. P., 61, Avenue Road, Regent's Park, N.W.	1	1	0
Reddall: W., 10, South Street, Finsbury, E.C.	1	1	0
Redmayne: G. T., 88, King St., Manchester	1	1	0
Rickman: T. M., F.S.A., 8, Montague Street, Russell Square, W.C.	3	3	0
Ritchie: R., 52, Parliament Street, S.W.	1	1	0
Roberts: R., 42, New Broad Street, E.C.	1	1	0
Robins: E. C., F.S.A., 46, Berners' Street, W.	6	12	0
Robinson: F. J., 45, Friar Gate, Derby	1	1	0
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Roumieu: R. St. A., 10, Lancaster Place, Somerset House, W.C.	1	1	0
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Scamell: George, F.G.S., Gayton, Avenue Road, Crescent Road, Crouch End Hill, N.	2	2	0
Scott: J. O., 31, Spring Gardens, S.W.	2	2	0
Seddon: J. P., 1, Queen Anne's Gate, S.W.	1	1	0
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Solomon: Lewis, 7, Gray's Inn Square, W.C.	1	1	0
Stevenson: J. J., F.S.A., The Red House, Bayswater Hill, W.	2	2	0
Stock, Page & Stock: Messrs., 6, Duke Street, London Bridge, S.E.	2	2	0
Stonor & Sons: Messrs., 2, Blomfield Street, London Wall, E.C.	2	2	0
Tabberer: Benjamin, (1885 & 1886): 10, Coleman Street, E.C.	2	2	0
Tanner: A. W., (1885): 29, Pelham Place, South Kensington, S.W.	1	1	0
Tasker: G. R., 3, Cumberland Terrace, Lloyd Square, W.C.	1	1	0
Tate: A. L., 20, Cooper Street, Manchester.	1	1	0
Thurston: C. B., F.S.A., 9, New Inn, Strand, W.C.	1	1	0
Tolley: James, 66, Cannon Street, E.C.	1	1	0
Truefitt: George, 5, Bloomsbury Sq., W.C.	1	1	0
Tucker: Samuel, 33, Argyll Street, W.	2	2	0
Turner: John, 15A, Wilton Street, Grosvenor Place, W.	2	2	0
Turner: J. Goldicutt, 15A, Wilton Street, Grosvenor Place, W.	1	1	0
Usher: J., St. Paul's Square, Bedford	1	1	0
Verity: Thomas, 27, Regent Street, W.	5	5	0
Vernon: A., High Wycombe, Bucks	1	1	0
Vulliamy: George (deceased)	1	1	0
Wadmore: J. F., Tunbridge, Kent	1	0	0
Walton-Wilson: J. W., Shotley Hall, Northumberland	2	2	0
Ware: C. N., 21, Princes Gate, Kensington, W.	2	2	0
Waterhouse: Alfred, R.A., 20, New Cavendish Street, Portland Place, W.	2	2	0
Watson: Fothergill, Clinton Street, Nottingham	1	1	0
Watson: T. H., 9, Nottingham Place, W.	2	2	0
Watson: T. L., 108, West Regent Street, Glasgow	1	1	0
Webb: Aston, 19, Queen Anne's Gate, Westminster, S.W.	1	1	0
Weightman: W. H., Minster Buildings, Church Street, Liverpool	1	1	0
Weir: James, 9, Victoria Chambers, Westminster, S.W.	1	1	0
Welch & Atkinson: Messrs. 10, Lancaster Place, W.C.	2	2	0
Wells: Thomas, 14, Manchester Square, W.	1	1	0
Westminster: Duke of, K.G., Grosvenor House, W.	5	0	0
White: W., F.S.A. (1885): 30A, Wimpole Street, W.	1	1	0
White: William H., 9, Conduit Street, Hanover Square, W.	1	1	0
Willey: Robert, 66, Ludgate Hill, E.C.	1	1	0
Williams: George, Dolmelynllyn Hall, Dolgelly, N. Wales	1	1	0
Williams: G. Barnes, 4½, Frederick's Place, Old Jewry, E.C.	1	1	0
Williams: James, 12, Edith Grove, Fulham Road, S.W.	1	1	0
Williams: Thomas, 4½, Frederick's Place, Old Jewry, E.C.	1	1	0
Winstanley: H., 10, Basinghall Street, E.C.	1	1	0
Witherington: W. S., 79, Mark Lane, E.C.	1	1	0
Wood: Sancton (deceased)	101	1	0
Woodhouse & Morley: Messrs., Bolton, Lancashire	1	1	0
Woodthorpe: Edmund, 2, Coleman Street Buildings, E.C.	3	3	0
Worthington: Thomas, 110, King Street, Manchester	1	1	0
Wyatt: Matt., 9, Gray's Inn Square, W.C.	1	1	0

TOTAL AMOUNT OF CONTRIBUTIONS TO THE ARCHITECTS' BENEVOLENT SOCIETY FOR THE YEAR ENDED 31ST DECEMBER 1886, VIZ:—

Subscription for 1885	15	15	0	
Subscriptions	350	12	0	
Donations	599	16	0	
				£966 3 0

J. MACVICAR ANDERSON, *Hon. Sec.*
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9, CONDUIT STREET, HANOVER SQUARE, LONDON, W.

found at Königswalde on the Oder, around the pulpit of St. Ambrose at Milan, in the Catacombs at Rome, on a Celtic urn at Shropham in Norfolk, and on Corinthian and Attic vases. It also appears upon the celebrated cinerary urn found some years ago at Colchester, where it is a portion of the ornament upon a shield of one of the figures there seen in combat. We have likewise met with it upon Roman glass from London excavations. The Rev. J. C. Bruce has recorded its presence on a Roman altar dedicated to Jupiter, found at Amboglanna, the modern Birdoswald in the North of England, where it is associated with the Greek cross. and it appears on an altar dedicated to Minerva, from High Rochester, now in the Museum at

Alnwick Castle. Mr. M. J. Walhouse, in an article on the Svastika in the *Indian Antiquary** for July, 1878, refers to its existence also in China and Japan. It is there seen on the lids of coffins, being supposed to act as a charm to protect the corpse against the attack of a demon, in the shape of a cat called Kinasha, which is said to seize and mangle the dead bodies of human beings. It may be seen in heraldry, and it was repeated upon ecclesiastical vestments with doubtless a belief in its efficacy as a charm. It is also to be found on ancient bells in some of our parish churches, illustrating, as remarked by Mr. Walhouse, the belief in demons, the powers of the air being driven away by the clang of church bells. On our pavement at Morton, the position of the emblem (see woodcut) is at the head of this chamber (No. XII). It was probably the site of an altar or a presidential chair, the former if the chamber were used for religious ceremonies, and the latter if as a hall of justice. It is an interesting feature, not only in this but in all the mosaics found, that they are made from

* See, page 159, an extract from this article, entitled, "*Trojan and Indian pre-historic pottery and the Svastika symbol.*"

native materials; the various colours which have been selected for the plumage of the birds, drapery and costumes, are such as may be picked up on the shore by Whitecliff and Sandown at the present day. Comparatively few things were discovered in this room. There were several fragments of pottery of common kinds, and a great many pieces of worked stone. A spindle whorl of hard wood, 2 inches in diameter, was found upon the floor. A large quantity of plaster, off the walls or ceiling, was lying face downwards upon the pavement, and some of the colours on it were very bright, but none indicated any especial design; there was a fair amount of plaster still adhering to the walls of this room, with fresco painting upon it representing scrolls in dull colours. We also found some plaster roundels for inlaying in the wall, a quantity of small iron nails for fixing on the roof-slabs, and some large nails, or spikes, as they are sometimes called, used for fixing the beams and rafters. Upon the pavement, in the west end of this chamber, was picked up a piece of kennel coal, which goes far to prove that the Romans used that fuel in the Island, especially as remains of mineral coal have been met with in other Roman villas in Britain; a large quantity of unburnt coal was found near the hypocaust at Wroxeter. A piece of deer's horn, 3½ inches long, which bore marks of having been cut with a sharp instrument, probably used as a handle of some implement, was here found. Upon the floor of this chamber an iron spearhead, measuring 8½ inches in length, was picked up. At the south-eastern corner of this room, at the end of the Medusa pavement, is an earthenware drainpipe fixed in the wall a little above the level of the present floor.

CHAMBER NO. XIII.—A singular structure, which consists of rough stones and measures 7 feet 9 inches long by 3 feet 10 inches broad and about 2 feet deep, paved with large red tiles, similar to those found on the floor of Chamber No. X. This structure extends on the east, where the wall projects fully 18 inches; it has been coated inside with salmon-tinted mortar, and on the east side of the compartment a wall has been inserted, which is found to be a continuation of the main wall running northwards; this addition is built of rougher masonry and common, badly-made mortar, indicating a later date. At Carisbrooke is a similarly-shaped chamber of semi-circular form and of nearly the same dimensions, it being 7 feet 6 inches in length, 4 feet in width and 16 inches in height, formed of tiles coated with cement, and an aperture for carrying off the waste water—it was in close proximity with a hypocaust—but in the present case the space in front is all open, suggesting that this building faced on to a garden.*

CHAMBER NO. XIV.—This, which is 15 feet 4 by 10 feet 2 inches, has a concrete floor; the walls are low and in certain parts the plaster still remains on the wall, which is of a dull blue colour, splashed with red and black in imitation of marble, such as have been so fully illustrated by Mr. Ecroyd Smith in his work on Isurium,† the modern Aldborough of Yorkshire. The fresco‡ which was dug up from off the floor, lying face downwards, as was the case throughout, was of very bright colours, but none of the fragments denoted any subjects. Beyond a few roof-tiles, pieces of coarse pottery and animal bones, small bits of glass, iron

* See under the head of "*Hemicyclium*," in Dictionaries of Greek and Roman antiquities, for a probable explanation of this structure.

† See *Reliquiæ Isurianæ, or the Remains of the Roman Isurium*, by H. Ecroyd Smith, 1852.

‡ The subjects and ornaments depicted in colour upon the fragments of plaster found in the excavations as well as on that still adhering to the walls, are rude in execution and much obliterated. Some, however, have been skilfully copied in water-colours by Mrs. Thorpe, of Yarbridge.

nails and the handle of a glass vase, very little else was discovered, excepting some very large and thick fragments of wall plaster with green flowers and other colours depicted upon them, but they could only be extricated in small pieces. Mazois writing upon stucco and wall plaster has expressed his opinion, founded upon his personal observation, that the stucco will be found thinner in proportion to the age of the building, and that thick stucco intimates a late date and the decline of art.

Chamber No. XV.—This was warmed by a hypocaust and is of unusual interest. The chamber measures 15 feet 2 inches north and south, by 10 feet 7 inches east and west. It contains fifty-four pillars of tiles arranged upon a floor of rough cobble stones; a large tile is placed upon the floors to carry the others, which are 8 inches square and 1 inch thick, with mortar joints 1 inch in thickness. These pillars are 2 feet 6 inches in height and consist of about 13 tiles each. On the east side of the wall are two flue-tiles *in situ*, 16 inches in length, joined together (see woodcut), thus making a flue of 32 inches leading to the upper portion of the room, and another on the north side. On the west side, and in the southern corner, is a neatly turned arch of large flat tiles with wide mortar joints; at the mouth of this arch a large stone of massive size was found placed across it. This arch represents the *præfurnium* or furnace on the outer side of the wall of the chamber, which is partially excavated in order to find the entrance to the arch; it had a similar large stone across the opening, already mentioned as occurring on the inner side. This has now been cleared, and the hearth between the stones exposed. At the mouth of the furnace are two projecting piers formed of tiles, but in other respects resembling the method of construction adopted in the *castrum* at Jublains in France. In constructing this hypocaust every advantage has been taken of the natural inclination of the soil, the superficial earth being alone removed and blocks of stone, for the purpose of foundations, being laid in a sloping direction for the reception of the rubble wall. Of the tile pillars one alone has the large tile upon it which served to support the superincumbent floor, this tile measuring 11½ inches square; the smaller tiles measure 8 inches square. The stones which form the furnace are about 2 feet long by 18 inches and 12 inches thick respectively. The arch itself is 2 feet wide and about 3 feet high, the thickness about 20 inches; it is entirely formed of tiles which are 11 inches square, and separated by mortar joints of like thickness to the tile, which is about 1½ inches thick. The hypocaust, invariably associated with Roman buildings in this country, usually accords in construction with the rules laid down by Vitruvius and Pliny. Its introduction and application is said to have taken place about the time of Seneca, from which period it seems to have come into universal use. The pavement of this chamber has been all destroyed. It was probably a plain concrete floor, for if of tessellated work we should have found traces of the broken débris, but nothing save the ordinary mortar-like composition was discovered above the tile pillars; the presence of these is, however, sufficient to prove that the pavement of this room was an example of

the *suspensura* or suspended floors. In the South of England these were generally formed of brick and tile, but in the military stations of the north greater strength was required; the floors necessarily were more substantial than ornamental, and were often constructed with massive slabs and flagstones, resting on square pillars of brick or stone. Slabs so applied at the station of Cilurnum (Chesters), in Northumberland, measured from 2 feet 6 inches, by 4 feet, to upwards of 7 feet by 3 feet, and were from 4 to 5 inches thick. In one room there were discovered no less than forty-eight supports for the pavement, each about 2 feet square, and the sub-structure in another comprized 24 such columns. Similar plans have been observed at Netherby, 10 miles from Carlisle, one apartment containing thirty-six pillars of square tiles ranging to a height of 3 feet, and in another no less than fifty-four pillars of solid stone were counted; and this, singularly enough, is precisely the same number as those discovered at Morton. At Chesters, also, we find the sandstone of the district utilized in place of tiles. In the local museum is an example probably extracted from the hypocaust found in Bridge Street, an account of which is given in the Journal of the British Archæological Association. Sometimes such supports were used in conjunction with tiles or with tubular pipes or flue-tiles placed on end. The most interesting example yet found in Britain is probably that excavated some years since at Cirencester. It presents some peculiarities, but well exhibits the general arrangements of a hypocaust beneath a tessellated floor. One of the supports is a stone pillar, another stands upon a stone base; between the last row of pillars and the side wall is a row of upright flue-tiles, and in the wall itself are two apertures, intended no doubt to convey the hot air into the upper part of the building. This chamber was apparently roofed with slabs of Bembridge stone, averaging in size 19 to 20 inches long and 12 inches wide, the nails for fastening being in many instances preserved.

Chamber No. XVI.—This room is 17 feet 3 inches long by 10 feet 7 broad; the walls were painted originally with a red fresco, some of which still remains in patches; the floor is paved with concrete. At the south-east side of this room is a passage way leading into No. XVIII. A considerable number of flat roofing-slabs, 18 inches by 12 inches, many with nails in them (they are formed out of Bembridge limestone), were found amongst the débris, likewise a quantity of fragments of Durobrivian pottery of fine texture, ornamented with scrolls in slip; two Samian bowls, which were unfortunately very much broken, but enough of them was collected to repair them sufficiently to show their shape, both being 9½ inches in diameter by 3 inches high, but of different shapes. The potter's names are illegible, being nearly rubbed out. In this room a large and strong iron tripod stand was met with, the ring of which is 5½ inches in diameter and 6½ inches high. (See Illustration No. 11, fig. xx.) There was likewise a considerable quantity of fragments of coarse pottery. The red lustrous ware, commonly called Samian, was not manufactured in England to any extent, the principal seat of its manufacture being Italy, Germany and France. Many moulds were discovered in a pottery kiln at Lezoux, in Auvergne, of a pattern* well known in Roman sites in Britain; and it is highly probable that most of the ornamental so-called Samian pottery was imported from Gaul. At the same time certain descriptions of this beautiful ware were made in Britain, as the moulds employed in its fabrication have at times been found; a fragment for one of the larger bowls, recently discovered at York, may now be seen in the museum of that

* See the *Traité des Arts Céramiques ou des Poteries*, by A. Brongniart, Paris, 1854. 8vo.

REMAINS OF ROMAN BUILDINGS NEAR BRADING, ISLE OF WIGHT: (No. 11)

J. P. Emslie, del. J. P. & W. R. Emslie, lith., London.

OBJECTS DISCOVERED DURING THE EXCAVATIONS.

city. The quality found in the Roman remains, now under consideration, is very similar to that which has been dredged up from the Pan rock off Whitstable, Kent. It is without ornamentation. The superior sort, decorated with designs of various subjects in relief, was greatly prized by the Romans, as is shown by many fragments of the ware having been found in London and elsewhere, mended with leaden rivets. Upon clearing away the débris from the entrance into the passage leading to room No. XVIII, we found the earth very black, being filled with fragments of burnt wood. Upon sifting it sixteen bronze studs were picked out, also a key with a bronze handle (see Illustration No. 11, fig. vii.), 5½ inches long, and two bronze handles (see Illustration No. 11, fig. xiv.), 5½ inches in length; also four iron clamps, similar to those of a chest or coffer. These vary slightly in size: two are 2¾ inches long by 2¼ inches wide, the margins nearest the nail holes are ornamented with crenelated borders; another rather heavier clamp is 3 inches long by about 2 inches wide, likewise crenelated on the outer margin. These were each fastened on to the wood by four nails, in two of the clamps three nails with flat heads still remain. A fourth clamp is a long and narrow strip of iron, 3½ inches long one way, 3 inches long the other, by 1½ and 1 inch in width; this has two large flat-headed nails in it, one of which is 1½ inches in length. Near the same spot at the entrance, which is 4 feet 2 inches in width, four iron hinges were found (see Illustration No. 11, fig. xi.), two of which are opened out wide, and two are half closed. One is 7½ inches long, and another is 7 inches in length; they are of wrought iron, and were fastened by four nails each; two of them have two flat-headed nails still in them, one has three, and a fourth has only one. In one the nail is 2 inches in length. Hinges very similar to these just mentioned were found at Pompeii; bronze handles of like pattern were also found there. It is probable that the large iron rings met with during the excavations at Morton appertained to door furniture. An iron hook and eye, probably part of the furniture of a door, were found amongst the débris at the entrance to room No. XVIII. The hook is 4½ inches in length, and the eye not quite so much; several other iron fragments were met with of less importance. The fact of finding all this furniture of a door or two doors, as they probably were, all together is most interesting. At the moment of destruction doubtless one door was shut, as one pair of hinges was wide open, and one door was open, as the other pair of hinges indicates, and the key and handles probably also belonged to it. The finding of indications in Britain of folding doors, applied to a dwelling house, recalls to classical readers the mention by Pliny of folding doors in his description of the Laurentian Villa. In the débris were found small shapeless pieces of bronze, likewise a third brass of Gallienus, in fair condition. A ferrule in bone (see Illustration No. 11, fig. v.), 1¼ inch in diameter and 1½ inch high, ornamented with small rings stamped round the edges, and many worked stones, were taken out of this chamber. A mortarium made of limestone, 2 inches in height and 6 inches in diameter, was found here; it has only one projection, which formed either a handle or an ornament, though it must originally have had three of them. Upon some of the rims of pottery found in this chamber were crosses made with a sharp instrument, probably the marks made by their owners to recognize one pot from another. (See Illustration No. 11, figs. vi, xv and xvi.) Several pieces of pottery found at Cirencester, now in the museum of that town, and others found at Silchester, bear incised letters and marks, made subsequently to the firing of the ware. The remains of a vessel in red earthenware, of soft paste, similar

to what is styled pseudo-samian, were here found; the spout of this vessel is 2 inches long, and as it is furnished on the inside with several holes it evidently was a wine strainer.

Chamber No. XVII.—This is 19 feet 5 inches long from east to west, by 10 feet 3 inches wide. The floor is composed of concrete, and the walls, which are now only about 2 feet high, were covered with stucco, a small quantity of which still remains, the colour being dull blue splashed with red and black. This chamber communicated with No. XVIII by a stone step 1 foot high, 2 feet broad, situated about the middle of the wall. In the course of clearing out the fallen débris, several large nails or spikes, varying in size from 10 inches to 13 inches, were thrown out; these appear to have been used for fixing the rafters of the roof and the side posts or supports, as in several instances these large spikes were removed from the tops of the wall, where they were lying in a horizontal position, as though they had been driven in to fix the up-rights. This chamber was chiefly remarkable for the large quantity of window-glass it contained. The glass is of various colours, some bluish-green, and some a drab colour; upon one side it is smooth and polished, whereas upon the other it is rough, like ground glass. The thickness of the largest pieces is from $\frac{1}{8}$ to $\frac{1}{4}$ of an inch. The largest piece of window-glass we exhumed was $7\frac{3}{4}$ inches in length by 4 inches in breadth, of a brownish-white colour, and $\frac{1}{8}$ of an inch in thickness, with a rounded selvage edge. The next largest fragment was a piece of green glass, which is $\frac{3}{16}$ of an inch in thickness, and 6 inches long by 3 inches in breadth. We also met with bluish-green and yellowish-green glass, and one piece was $\frac{1}{4}$ of an inch thick near the selvage edge. One fragment has two outer edges rounded; it is a matter of regret that we have not sufficient of these fragments to form a whole sheet, but it is so far interesting to possess one showing the selvage edge on two sides, thereby giving us a clue to the manner in which they were cast for fitting into the frames. In this chamber, No. XVII, all the glass was found upon the floor. Window-glass, of exceeding rarity in Roman remains in this country, has been found amongst the débris of Roman houses in London, of a semi-transparent kind of greenish hue, and also at Hartlip, in Kent, where the edges of two sides were unbroken and rounded for fitting into a frame; similar pieces of glass showing the selvage edge have been found at Silchester and Colchester. Window-glass of like quality has been also found at Cirencester, which Professor Church calls window or skylight glass. Fragments of window-glass have likewise been met with at Pompeii, as mentioned by Mazois; and in Becker's *Gallus** there is a reference to a window found in one of the rooms of the Thermæ at Pompeii, containing glass, set in a bronze lattice frame, slightly ground on one side in order to prevent people from looking through. That Pompeian glass, the fragments of which were found at the excavation, has been called plate glass, but it was in all probability of a similar quality to that found by us at Brading, which is blown glass. It is stated by Pliny and others that thick sheets of glass, of various colours, were sometimes used for paving floors and decorating the walls and ceilings of houses; but it is very improbable that such was the case at Morton. Glass, according to Pliny, appears to have been made much in accordance with modern practice; it might be blown, cast, cut or ground on the lathe, and carved or engraved with some sharp tool. Two specimens of this thick window-glass, found by us

* The reference occurs in the Excursus on the Baths, in which Sir William Gell's description is quoted, and interpolations by Becker are given. See *Gallus or Roman Scenes of the time of Augustus* (page 273), by Prof. W. A. Becker, Lond. 1873. 8vo.

at Morton, have been submitted to Mr. W. H. Hudleston, F.G.S., F.C.S., for analysis, and he reports as follows: Quantitative analysis of two pieces of glass—No. 1, Clear glass, with a pale brown tinge. This is a silicate of lime and soda, with some alumina, and very small quantity of magnesia. Oxides of iron and manganese are both present, the latter probably in excess. No. 2. Clear pale greenish glass. This is a silicate of lime and (probably) soda, with a fair amount of alumina and (perhaps) traces of magnesia. Oxides of iron and manganese are both present. These two pieces appear to contain the same ingredients, and the difference of colour is most probably due to the different state of oxidation of the iron and manganese; the latter, No. 2, would seem to be in a fresher condition. This analysis shows that the glass found at Morton is a soda lime glass with some alumina, and in this respect resembles the ordinary English window-glass, as analyzed by Richardson, which is as follows:—

Silica	66·37 per cent.	Lime . . .	11·86 per cent.
Soda	14·23 „	Alumina . . .	8·16 „

There is a marked absence of potash in our Roman glass, and in that just described. English plate glass contains the following ingredients:—

Silica	77·90	Lime	4·85
Potash	1·72	Alumina	3·59
Soda	12·53	Ferric oxide	

The presence of oxides of iron and manganese in our Roman glass proves that impure sand, chalk and salt were probably used in its manufacture, as such ingredients would not be purposely added. Mr. Rudler, of the Museum of Practical Geology, has given us the following analysis of some flat pieces of glass in that museum, similar to common window-glass, supposed to be of Roman origin, namely:—

Silica	71·95	Protoxide of manganese . .	·57
Soda	15·30	Magnesia	·60
Lime	7·33	Alumina	trace
Protoxide of iron . . .	3·45		99·20

In this same chamber a considerable quantity of fragments of very fine glass, portions of cups, bottles or vases, were found, but all in such a crushed condition that renovation is out of the question. The fragments include specimens of olive-green lustrous glass, of which we have sufficient of the rim to show that it belonged to a vessel of considerable size, the diameter being 3½ inches. Several pieces of a bottle of this olive-green glass, ornamented with pillar moulding, were also found. The art of pillar moulding was, until about twenty years ago, considered to be a modern invention, a patent for which had been taken out by a Mr. James Green; but this was proved to be a delusion by the discovery of some fragments of bowls of great beauty, in London and on the Continent, showing that the art of pillar moulding was well known to the Romans. One of the finest illustrations of this style of work is that of the large bowl found at Hartlip, in Kent, and portions of similar vessels in dark blue and green, were found some years since on the site of St. Benet's Church, Gracechurch Street. A part of the base of a cup or vase of white opalescent glass, apparently turned upon a lathe, likewise showing pillar moulding, was found in this chamber; some of this glass is of

extreme fineness. Also two bases of vases of sea-green glass, which are very thin, one base measuring $2\frac{1}{2}$ inches in diameter, and the other $1\frac{1}{2}$ inches; a portion of a glass plate, sufficiently large to show it was 5 inches in diameter of the same colour, with a slightly turned-over rim, its thickness being about one-sixteenth of an inch; the neck of a bottle in white glass, of very thin fine quality, the diameter of which is $2\frac{3}{8}$ inches at right angles to the handle, and $2\frac{1}{4}$ inches the other way; and part of the handle of an urn, $2\frac{1}{4}$ inches in width. The fact of discovering so many fragments of fine glass vessels in the excavations at Morton has been the subject of great surprize to many people visiting the excavations, who did not seem to realize the fact that the art of glassblowing was so ancient as it is; so, for their benefit we venture to state that it was known to the Egyptians as early as the eleventh dynasty. Representations of glassblowers are depicted upon the walls of Beni Hassan of as early a date as that of Usertesen the First, more than 3,500 years ago. Glass for ordinary domestic vessels was in general use among the Egyptians, Greeks and Romans; and it can be positively asserted that about B.C. 1500 the Egyptians made ornaments of glass—a glass bead having been found at Thebes bearing the name of Queen Hatasu, sister and co-regent of Thothmes II., of the eighteenth dynasty. The earliest dated piece of glass is a dark blue fragment impressed with the name of Antef III., of the eleventh dynasty. It is uncertain whether the Egyptians or the Phœnicians were the first inventors of it; they made all sorts of domestic utensils, and imitated gems. Pliny, in later times, informs us that glass vases superseded those made of gold or silver. The Portland vase, which is of course one of the finest examples of the art known, was discovered in a tomb near Rome. In fact, it is very doubtful whether, even at the present day, we can make such magnificent specimens of glass as were made by the ancients. The Romans probably manufactured glass whilst they were in Britain; a great quantity of fine examples are constantly exhumed wherever Roman excavations have been undertaken. A Roman glass manufactory is supposed to have existed between Brighton and Rottingdean, Sussex*—the late Dr. Guest, in 1848, having at that spot, picked up considerable quantities of lumps of glass of various colours which had been made into *massæ,* to be afterwards sent off to different glassblowers for transforming into vessels. Possibly the Romans made glass in Britain, and the sands of Alum Bay and Whitecliff Bay would be suitable for the purpose. At the collapse of the Empire the art, like many others, gradually declined, and though examples are frequently met with among the graves of the Franks and Saxons who occupied this country in the fifth and seventh centuries, we miss much of the taste and beauty which prevailed in earlier times. The glass cups of the Saxons were, however, well made; they were fluted and decorated with bosses, but usually pointed at the end, so that they could not stand upright, but would have to be held by the hand until emptied. They were largely imported from the Rhine, the manufacture having well nigh died out in Britain. It is asserted by the Chronicler Bede that the art of glassmaking was unknown in Britain in the seventh century. Abbot Benedict, he also writes, brought over artificers from France skilled in making glass, which until then had been unknown in Britain, wherewith he glazed the windows of the Church of Weremouth, and taught the English the art of glassmaking. This is in A.D. 674, and is perhaps the earliest mention of the art subsequent to the Roman period. The manufacture, however, must have been continued, because we find indirect allusions to it

* See *The Celt, the Roman, and the Saxon* (page 225) by Thomas Wright, M.A., London, 1852.

among the early English records. A reference exists in the City archives* to an individual whose name clearly attests the presence of this branch of industry in the fourteenth century. A quantity of pieces of Durobrivian ware of very fine quality were here met with, but in too small fragments to enable us to repair any vessel; there were also numerous iron nails used for fixing on the roof-tiles, and large iron spikes for the rafters. We found here a considerable amount of pottery (some we have been able to repair): namely, a large two-handled vase of black ware, 10 inches in diameter and 4½ inches in height; a large Samian bowl, 11 inches in diameter by 4 inches in height (the potter's name is illegible); a bronze stud, seven-eighths of an inch in diameter, ornamented with flutings radiating from the centre; a bronze spoon (see Illustration No. 11, fig. xii.), 2¼ inches across the bowl; a cut bone handle, 3½ inches in length; the blade of an iron knife, about 3 inches long; a large bronze stud or ornament for a belt (fig. ii.), 1½ inches in diameter; an iron socket of a staff, 9 inches long (fig. xxi.); a small vase of black pottery (fig. ix.), 3½ inches high and 7½ inches in circumference, of the kind known as New Forest ware; two third brass coins of Severus Alexander and Trajanus Decius, and a minimus of the Gaulish type of Tetricus. An elegantly shaped jug or bottle (fig. x.),† 5¾ inches high and about 4 inches in diameter in its widest part, the mouth of which is pinched up, much in the shape of a trefoil, was found. The body of the jug is black, ornamented by four pairs of vertical stripes of white, arranged at tolerably even distances apart. This was much broken, but enough of it was found to enable us to restore it sufficiently to show the form. A red jug, 6½ inches high and 4 inches in diameter, having originally two handles (one has been lost), composed of a soft red paste, was also found, but much broken. A ring of red ware—a kind of pseudo-samian—was found, measuring 2⅝ inches in diameter. It is a matter of doubt for what purpose this ring could have been used, unless it was as a handle to a vase (we have a piece of pottery from Barge Yard, London, with a handle, and within the handle is a ring inserted, 1½ inches in diameter). Among the most remarkable things found in this chamber is a *scutra* or tray formed out of Kimmeridge shale; it was lying upon the floor with a considerable portion of another. One tray is of an oval form, but the rim is wanting; it is 11½ inches in length by 7 inches in breadth, and on the base is a slight oval foot or stand, lozenge-shaped, which is 9 inches long by 4¾ inches broad. Of the other tray we only discovered half. It must have been round, from the fact of the stand being circular; it would have been 16 inches in diameter. These trays remind one very much of papier-maché goods of the present day. They have all been turned on a lathe. This substance was extensively used by the Romans of Britain for the manufacture of personal ornaments. Some interesting flat plaques or trays, richly decorated, were discovered some years ago at Jordan Hill, near Weymouth; they are now in the British Museum. Fragments of similar objects were found near the Mansion House, London, and they are preserved in the museum at the Guildhall. A piece of shale carved with scroll pattern was found at Silchester, and is now in the little museum on the ground. Ornaments made of the same

* See *Memorials of London and London Life in the Thirteenth, Fourteenth, and Fifteenth Centuries*, by H. T. Riley, M.A. In Letter-Book G we find mention of Thomas the Glaswryghte. The calling is here as much specified as is Richard the Mirorer, or Maker of Mirrors, Richard the Lacer or John the Bokelsmith.

† These figures are contained in Illustration No. 11. Referring thereto, fig. xvii. represents a bowl just unearthed (Sept. 1881), at a short distance from the present excavations. The object indicated in fig. iii, not alluded to in the Paper, was found next the remains of wall (shown in Illustration No. 7) opposite Chamber No. VI.

substance have been found at Cirencester. The general use of this material for artistic purposes, by the Romans in Dorsetshire, has been illustrated by Mr. Charles Warne, F.S.A., in his history of that county, and more recently its use has been discovered by Mr. Middleton, while excavating a Roman villa at Fifehead-Neville, in the same county. A large piece of lead was found in this chamber, which from shape and appearance seems to have been molten. When the shale trays were being extracted from the débris a bronze vessel was discovered for which we are unable to assign a use, unless it was a lamp. The upper portion is 2½ inches high and nearly 2 inches in diameter; this evidently fitted into a stand, the fragments of which, when put together, measure 4½ inches in diameter. It is extremely fragile and past reparation. A flat piece of wrought-iron plate was picked out, measuring 4½ inches long by 2¾ inches wide in the widest part, having two holes in it for fixing nails.

Chamber No. XVIII.—This measures 21 feet 6 inches from north to south, and 18 feet 6 inches from east to west; the floor is of concrete, with a red fillet round the margin of the wall. The plaster is still remaining in parts and exhibits colouring of a dull blue ground, splashed with red and black in imitation of marbling, as was the case with Nos. XVII and XIV, and at the Roman villa discovered at Aldborough, Yorkshire. There was very little found in this room beyond a fine example of a bronze handle of a key of elaborate workmanship, 3¼ inches in length, finely patinated, and a little over one-third of an inch in thickness; also a portion of a handle of a door in twisted bronze, with a central boss of solid bronze, some fragments of coarse pottery, iron nails, &c.

Chamber No. XIX.—This measures 9 feet by 10 feet, but it contained nothing beyond a few fragments of pottery, tiles, &c.; this chamber leads out of No. XXII, the edges of the plaster on each side of the entrance being rounded.

Chamber No. XX.—This is situated due east of the preceding one, and is 19 feet 8 inches in length by 9 feet in breadth. There is evidence of an alteration having been made in this chamber, as along the southern side of it, a stone wall has been constructed up against the original wall of the building, behind which stone wall we find the wall-plaster with coloured fresco upon it. There was very little found in clearing this room, beyond stone roofing-slabs, part of the tine of a deer's horn, cut off with a saw, and some bits of Samian and black pottery.

Chamber No. XXI.—This measures 21 feet 3 inches by 9 feet in width, and it has an opening into No. XXIII, 6 feet 7 inches broad, at 11 feet from the west end of the chamber; the wall is extremely rotten and friable. The footing of the wall on the north side is about 3 feet in width and projects about six inches on either side of the wall. There is no pavement in this chamber. Fragments of pottery, iron nails, blade of a knife, stone roofing-slabs, horn core of *bos longifrons*, and bones of domestic animals, were here found.

Chamber No. XXII.—This is situated in the centre of the northern wing, measuring, from the east end of room No. XVIII up to a cross wall, 54 feet by 21 feet 10 inches in width. Arranged along the wall on the north side are five piers; commencing from the west end are two stone blocks of squared stone, placed at certain distances apart, followed by three piers of rough concrete blocks, which have been constructed by holes having been dug into the upper greensand, and a layer of lumps of greensand placed along the bottom of the pit so dug out, and then filled in with mortar, mixed with pieces of stone and chalk;

these appear to have formed the foundation for columns, which probably supported the roof of this extensive chamber or court. On the south side are five similar blocks, formed in the same manner as the last three, exactly opposite to those on the north side. The first three, from the western end, are placed along the footing of the wall, the other two are detached, there being no traces of wall in between. The remains of the wall on the east side are about 18 inches in thickness; the pavement appears to have been formed of rough concrete. In this chamber the following articles were found, namely, a quantity of pottery, including Samian, black, yellow and whitish in fragments, and a small vase of Durobrivian ware nearly perfect, with panels pinched in; oyster shells, iron nails, a piece of window-glass, stone roofing-slabs, a bronze hinge, an iron chisel, several pieces of bronze, some having circular bosses punched out on them, and a large plate of a lock, which latter probably formed portion of a chest. These pieces of bronze were discovered near the western end. The lock plate (see Illustration No. 11, fig. xxii), measures $8\frac{3}{4}$ inches square, and was fixed on by 8 nails. The lock itself is much corroded; attached to one side of it is a flat piece of bronze, shaped like a vase (fig. viii), $4\frac{3}{4}$ inches in height.

Chamber No. XXIII.—This is situated due east of No. XXII; it measures 39 feet 8 inches in length by 32 feet in width. The base of the wall on the north side is 3 feet in thickness and the wall itself is 2 feet thick. At 6 feet 6 inches from the western end, on the north side, the wall is irregular and the stones appear to be laid more on edge, forming half circles; this is probably a portion of the basement of the wall, as the layer does not extend beyond the footing on either side. At a distance of 8 feet, and 8 feet 4 inches from the north wall southwards, are three square blocks of concrete. These blocks, probably intended for supporting columns, are at intervals of 6 feet to 6 feet 10 inches apart. At the eastern end of the north wall is a square block, at 12 feet from the wall southwards is another, 7 feet 9 inches further south another. At the south angle of the wall of the well-house (at No. XXVIII), is the fourth block; up the south side of this chamber are four more blocks, arranged at certain intervals corresponding in position to those on the opposite side. The entrance to No. XXIII appears to have existed between the central blocks on the east end, and to have been approached by an outer chamber or vestibule, if we may so surmize, as at distances from 13 feet 7 inches to 14 feet are three larger blocks of stones placed edgeways; the fact of these existing in that position suggests the possibility of their being likewise constructed to support columns for carrying the roof, and as no wall has been met with at the east end, we are led to suppose that the entrance must have been there. No pavements have been met with in any of the rooms of this northern wing; they appear to have been wholly destroyed, in fact there are very few remains of walls to these last two chambers, what now exist being simply the foundations of the old walls. Very few relics were found in this chamber beyond fragments of Samian ware, black pottery, some nails and tiles.

Chamber No. XXIV.—This measures 28 feet 4 inches east and west, by 10 feet 9 inches north and south. The base of the external wall is 3 feet in width. There were no remains of pavement, and only a few fragments of pottery and some roofing-slabs were discovered in the excavation.

Chamber No. XXV.—This is situated east of No. XXIV, and measures 15 feet 10 inches in length by 10 feet 9 inches in breadth. Nothing but fragments of tiles and pottery were found.

CHAMBER No. XXVI.—This, measured from the wall of No. XXV up to the hollow basin west of the well-house, is 33 feet 4 inches in length; it may have been part of an external corridor, as no wall is found to the south of it. In line with the north wall of No. XXV three massive blocks of concrete occur.

CHAMBER No. XXVII.—This is a hollow basin, which, measured from No. XXVI up to the entrance to the well-house, is 14 feet in length; this basin, for which no use can be assigned, is hollowed out of the greensand rock. It may have inclosed the furnace connected with the hypocaust, indications of which have been more recently disclosed. On the east is the entrance to No. XXVIII, composed of two piers of good masonry with a string-course of tiles; the width of this entrance is 1 foot 11 inches. In course of excavating the well a large slab of stone (rebated) was got up, 1 foot 11 inches by 1 foot 6 inches in width. In the hollow basin a portion of the shaft of a stone column, 13½ inches in diameter, was found; this is the only fragment of a column yet met with, and it probably stood on one of the concrete blocks we have described. A considerable quantity of black earth, filled with débris of black pottery, nails, stones, portions of roofing-slabs, bones, charcoal, &c., were found, and all bearing evident signs of fire.

CHAMBER No. XXVIII.—This is of singular structure; it is situated upon the south-eastern side of this wing of buildings. Taking an inside measurement from west to east of the wall, which forms the southern boundary of Chamber No. XXIII, it is found to be 15 feet 8 inches. This chamber has an entrance at the west side, and contains two semi-circular apses. These semi-circles are of unequal dimensions, that on the west being 9 feet 10 inches from north to south, and that on the east 9 feet 3 inches. There is evidence of this chamber having been warmed by the hypocaust, for there are the remains of tile pillars still existing, which illustrate the presence of the *Suspensura* or suspended floor. The wall of this chamber is of good material, and in the western portion of it two short pieces of wall run from the main wall on the west side, but do not extend quite across to the opposite one. At a distance of 6 feet 5 inches from the west side, and 4 feet 9 inches from the east, is a well 4 feet 3 inches in diameter. It was completely filled up with earth and débris, the steining, if there ever had been any, had given way; the well was cut through the upper greensand, and the sides were firm and hard. We found it necessary to stein the upper 5 feet with bricks, to prevent the top soil falling into the well while the men were excavating. In the course of clearing out this well a great number of articles were met with. The débris comprized fragments of stone, tiles, pottery, bones and charcoal. At a depth of about 10 feet, some forty or fifty tiles were got out; they probably formed part of the floor of the chamber in which the well was situated. There were many 8 inches by 8¼ and 1¼ inches in thickness, 8¼ inches by 8½ and 1¼ inches in thickness, 16 inches by 12 inches and 1½ inches to 1⅝ inches in thickness, 10 inches by 10½, and 16 inches by 11 and 1½ inches in thickness. These tiles were nearly all perfect, some of the small ones were marked with large double crosses, others with crescents. Several shaped stones, one measuring 3 feet 5 inches by 1 foot 11 inches and 7 inches in thickness, were found. At 14 feet from the surface, several fragments of human bones were found, and these have been submitted to Professor Flower, F.R.S., of the Royal College of Surgeons; he examined and gave a description of them at the evening meeting of the Anthropological Institute, on the 26th April last.

Together with these remains, were the bones of three young dogs, the base of a Samian *patera*, snail shells and several pieces of wall plaster, having white colour upon them, some scratched with the mark of a cross. A large stone, measuring 5 feet 6 inches by 3 feet 9 inches, was also found. At about 20 feet, nails, stones, bones of pig, dog and ox, pottery, shells of snail, cockle, limpet and oyster, together with red tiles, were found. One of these tiles was 17 inches square and 2½ inches in thickness, marked with incised pattern and the impression of a human hand (see woodcut). More tiles 8 inches square, and some which perfect must have been 21 inches square, with a hole 1 inch in diameter at one side, but sometimes in the centre. Another tile 21¼ inches square and 3 inches thick, bears the impression of naked human feet and likewise hobnailed sandals and the pat of a a dog.* From about 25 feet to 57 feet, there was very little met with, the earth taken out having the appearance of fresh cut upper greensand, comparatively free from any external features. Below 57 feet, burnt tiles, fragments of black pottery and bones of ox were got out. At 64 feet, the excavations yielded quantities of fragments of pottery, black, red, Durobrivian, Samian, &c., lumps of chalk, a large number of flints and other pieces of rock, shore pebbles, bits of charcoal, bits of green window-glass, part of the cover of a black pot having a knob to it, oyster shells, part of a black pan, a large antler with saw marks, the base of a yellow pot, the horn core of a young ox, and a deposit of about 2 feet in thickness of animal bones, consisting of ox, horse, sheep, pig, dog, fowl, &c. There were fully two or three bushels of bones. At 70 feet, we met with clayey sand filled with bits of black pottery and fragments of charcoal, followed by a thick layer of black laminated mud; at this depth the water began to well up.† At 71 feet 6 inches, an iron strigil and a portion of deer's horn, bored probably for the purpose of fixing in some bronze tool; it had most likely been a pick. At 74 feet 8 inches, part of a large *amphora*, followed by blocks of stone, fragments of two or three millstones, oyster shells, black and other pottery. At 78 feet, we apparently

* At the Roman villa discovered at Acton Scott, along the line of road from Uriconium to Bravenium, large quantities of tiles were found, among them examples bearing impressions of the nailed *caligæ* of the soldiers, which must have been made previously to the baking of the tiles.

† We have spoken of this shaft or pit, with its varied and interesting contents, as a "well," and that, inclosed by adjoining buildings, it formed the reservoir whence water was collected for the daily requirements of the villa. The discovery of the four charred stakes of oak, the total absence of any form of "steining," the fact that it was not the Roman practice to sink a well in the interior of a building, such being usually external, as with country houses at the present day, together with the construction of a chamber above, warmed by the hypocaust, are circumstances yet to be explained. For the present the well theory is adopted, but it is difficult to understand how or when the shaft came to be filled up, or how so large a quantity of animal remains could have been gradually decaying in a receptacle containing water in constant requisition for culinary or drinking purposes. The shaft possibly may have been sunk for water and never utilized, and hereafter formed a receptacle for rubbish, or it may yet be ascertained that it has association with the Roman colonization of the district, and connected with the centuriation and limitation of the land. It was the practice when

reached the bottom, in which four oak stakes* about a foot in length were found; they had been charred; then more black pottery and pieces of Samian, two bearing the following potters' names, PVONI.MA. and DIVICATVS, the latter of which has been met with upon pottery found in London.

CHAMBER NO. XXIX.—This is situated to the east of No. XXVIII, and is detached. It has only three sides, the wall on the north side is 6 feet 5 inches, the south wall is 7 feet 3 inches, and the width of the chamber is 4 feet 2 inches. The walls vary from 1 foot 7 inches to 2 feet in thickness.

CHAMBER NO. XXX.—This, situated at the north-east end, is a subway, of much the same general appearance as that already described in Chamber No. VI. It is formed of squared stones, and the entrance is narrower than it is where it opens out into a channel east and west. The length of the wall from north to south is 11 feet 11 inches, width between the walls on the north 3 feet 2 inches, on the south 2 feet 7 inches; the height of the wall on the east side is 2 feet 7 inches, and on the west side is 2 feet 2 inches; the wall stands upon the upper greensand. The width of the top of the east wall is 1 foot 10 inches, and is composed of solid masonry, with a string-course of flat tiles 1 foot 11 inches from the top, and much of the masonry is jointed with salmon-coloured mortar. This part leads into a narrow passage at the north end, which passage is 1 foot 4 inches broad, and is much longer at the top than the bottom, the sides gradually widen as though by steps; the bottom length is 6 feet 6 inches, whereas the top length is 8 feet 8 inches. Along the north wall are the remains of six string-courses of red tiles; the height of this portion of the structure corresponds in great measure with the walls already described, that is to say, 2 feet 6 inches and 2 feet 2 inches respectively east and west. In this northern passage the wall varies much in thickness; taking it from the eastern end, for a distance of 3 feet 7 inches, it is only from 6 to 7 inches in thickness, whereas beyond that it becomes 3 feet thick, and forms the continuation of the base of the north wall. At the south end, that

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appropriating a newly-acquired province to apportion the soil among the colonists, in accordance with a well-defined system of surveying which perpetuated, in a new settlement, laws and regulations familiar enough in the mother country. The rules of the "Agrimensors," as connected with either public or private property, were observed throughout the provinces of the Empire, and their existence in this remote land of Britain has been fully proved. According to this system, terminal marks were placed at the intersection of boundaries such as should provide significant explanation to the professed surveyor. These would at times be above ground, protecting deposits beneath, which would still exist should the distinctive covering be at any time removed. Among these was the "*Arca finalis*," of which many examples have been found in Britain. This was a dry well, or pit, which, filled with objects of all descriptions, would indicate a *trifinium*, *quadrifinium* or other form of terminus. It is possible that our shaft, resembling as it does so many others, was associated with the early assignment of the property, and that in later times it was built over, covered in by the hypocaust and chamber above, and that, at the disturbance of the pit at the time indicated, the individual, whose skeleton we have lately found, by some unlucky chance fell in. The four stakes of charred wood are so significant of the "*palos picatos*," referred to by the old writers, that the subject is worth consideration. The suggestion is one which should lead to a study of limitary marks, the situation of roads and bye-ways, the boundaries of parishes, and other kindred matters connected with the early history of the Island.

* See, in the TRANSACTIONS, 1875-76, page 90, the President's description of a "well", containing remains of a similar description, discovered in Charlotte Row, Mansion House, London; also, at page 96 of the same volume, a Paper by Mr. Alfred White, F.S.A., an Honorary Associate of the Institute, on the antiquities found there. For the original account of the "*Arca finalis*," see Mr. John E. Price's *Roman Antiquities: Mansion House, London.*

is outside the entrance to this subway, two large flat slabs of stone were found at either side of the end of the wall, in a slanting position; the stone on the west side, which now remains, measures 2 feet 9 inches by 2 feet 6 inches, the opposite stone fell to pieces. At the back, and in fact all around the entrance to this subway, the débris was composed of blackened earth and pieces of wood, charcoal, bits of pottery and oyster shells. Between the south wall of the northern block of buildings and the open space, supposed to be a garden, is a roadway. This is formed of rough rubble stones, large flints and pieces of upper greensand. It extends from the wall at the west, No. XIV, and continues beyond the limits of the well-house. It is not of uniform width, but varies as follows:—By Chamber No. XIV the width is 11 feet 3 inches, at No. XXIV it is 14 feet 6 inches, at No. XXV it is 14 feet 10 inches, and beyond, it is 16 feet. Upon this roadway a denarius of Elagabalus was found. This roadway measures from the front of No. XIII to the eastern extremity 156 feet, and it has further been traced southwards from No. XIII up to the subway of No. VI.

Chamber No. XXXI.—This we are unable to associate with the chambers already described until further excavations have been carried out. It measures 23 feet 9 inches north and south, and 18 feet 2 inches east and west; the walls have squared stones at the angles. In connection with the excavation of this chamber, a bronze armlet, a *fibula* and additional coins are said to have been found.

Major LEEDS.—Mr. Chairman, Ladies and Gentlemen, we, in the Isle of Wight, look on these discoveries as a public source of interest more than a private one, and those who are locally concerned are most anxious to render every possible assistance to those gentlemen who come to explore and explain them. I can assure you that the owners of the land are doing all they can with that object; unfortunately, however, these discoveries have been made on two adjoining properties, and there has been a difficulty as to how we should throw them jointly open to the public, but we hope arrangements will shortly be completed, by which all difficulties will be overcome, so as to enable the whole area to be thoroughly explored and thrown open, when everything will be on a very different and more satisfactory footing than it is at present. Lady Oglander has contributed in every way by giving up the land for investigation, and I think it will be found that the explorers, who have reached the edge of the field, will have to extend their operations much beyond. The ground so far has only been shaved over as it were, so as to show the plan of what the surrounding buildings was; and I think I may say there are certain indications of the head of the road which was probably carried down to the head of the Haven, which, in former years, came much further up than it did in more recent times. A Roman causeway or road has long since been traced right across the Haven to a place called Centurions Copse, on the opposite or Bembridge side, which side in former years was, at high water, probably a separate island, to which this causeway would be the only means of access. I remember the then agent of Sir Henry Oglander, a few years ago, partially exploring a part of that spot, but nothing was found in the way of Roman remains—nothing but an old burying ground—nothing but some headstones, skeletons, &c., belonging to a more recent period than when the Roman fort or station existed. I have no more to add except our extreme thanks to the Messrs. Price, who have so ably conducted their operations, and our gratitude to the Royal Institute of British Architects

for the ready assistance afforded us. We on the spot warmly appreciate, I assure you, the kindness of the Institute.

E. W. BRABROOK, F.S.A.—You have heard so much, from the archæological point of view, of the interest which attaches to these remains, that I would rather like, instead of myself offering remarks, to hear the instructions which Members of the Royal Institute of British Architects are able to give on this matter, and reserve what is to be said, from an antiquarian point of view, for a future occasion and another place. I had the advantage of assisting my friends, Mr. John E. Price and Mr. Hilton Price, for a day or two, and I can testify to the thoroughness of their work, and to the necessity that it should be further prosecuted. It appears clear to me that there is a great deal more to be discovered, and that my friends ought to be encouraged to pursue their excavations until they have explored the whole of the ground.

Dr. WALLER-LEWIS.—I wish to ask a question upon which the authors of the Paper have not given us sufficient information, although it is of some importance, and one which will be easily answered. I think that the visitors and Members will be glad to know at what depth below the surface the remains were come upon, and the nature of the superincumbent soil. Those who have been in the habit of seeing Roman remains in this country have generally observed that they were buried at a considerable depth below the present surface, generally from 16 to 20 feet.

CHARLES FORSTER HAYWARD, F.S.A., *Fellow.*—I might perhaps just remind the meeting, with respect to the question of the depth at which these various remains are found, that at Colchester (the Roman Camulodunum) they are found very near the surface, and I myself have raked off a garden a small coin of the age of Constantine. There are certain portions of the town where you may be certain, at the depth of common digging, such as a foot or 18 inches, to find a quantity of Roman remains, and not only such things as cinerary urns, but even pavements similar to those just described, immediately beneath the surface. Within the last three or four years, one of the most interesting carved stone monuments was found there, and pottery more recently still. The soil is mostly of sand and gravel—no stone. The walls of Colchester are composed of septaria—nodules of clay or cement-stone—dredged up at Harwich and elsewhere on the coast, and built in a kind of rubble work combined with Roman bricks or tiles.

FRANCIS C. PENROSE, M.A., *Past Vice-President.*—I have not pursued this subject of the domestic architecture of the Romans in Britain, and therefore I shall confine myself to what I see immediately before me, and refer to these remarkable specimens of glass which have been discovered at Brading. In Italy, so far as I remember, I do not think glass was used for windows. The climate did not require it, and it has been tacitly assumed that the introduction of glass for domestic windows was a mediæval, not to say a gothic, invention; and in fact that our Saxon forefathers and even the early Normans were unacquainted with its use for this purpose. It seems to have been a luxury reserved for the churches in the earliest mediæval times, but here we have glass of respectable dimensions, used in this Roman villa. Here we have extremely pellucid glass and other glass of a fine green colour, so that both the colour and the luminous effect must have been considered. I also would remark on the wonderful preservation of the iron nails and other implements which are in the cases

before us. Usually when iron has been discovered in old remains it has been reduced to such shapes, by a large amount of oxidization, that it is very difficult to make anything of it; but really these nails and spikes would do to put into timber at present, and I have no doubt the iron is a good deal better than we could get at the present day.

EDWARD C. ROBINS, F.S.A., *Fellow.*—I have seen the Roman villa at Carisbrooke, and was very much interested in its exploration. That was very near the surface, and from what I see of the drawings here, this also appears very close to the present level of the fields. There is one question I should like to ask, as to Newtown in the Isle of Wight. I did not hear it mentioned in the Paper, but the present village is called *new* because it is supposed to cover an old town, whether mediæval or Roman I cannot say, and the streets of the old town are clearly marked out by the division lines of hedges that still exist upon the surface of the land. I do not know whether these gentlemen have visited Newtown, but I think something would be seen there which might be found worthy of exploration.

Mr. JOHN G. WALLER.—I came here rather to listen than to speak, as I do not think there is one subject in the matter before us which I thoroughly understand, except that named by Mr. Price as the Buddhist emblem, "svastica" 卐. I believe I was the first who, in England, published an account of it,* giving it that, its Sanscrit name; and my information was obtained from an article by Professor Wilson in the Journal of the Asiatic Society. Much about the same time, the late Mr. Albert Way and myself simultaneously discovered an English name for it. I believe it to be the oldest religious symbol of which there is any record, not even excepting those of the Egyptian mythology. Dr. Schliemann found it in the deepest excavations at Hissarlik, and much interesting matter may be found in his work on Trojan antiquities respecting the *svastika,* though one writer, whom he quotes, cannot be thoroughly depended on. There seems, however, to be a concurrent opinion that it was an emblem of the early worship of fire. However this may be, our interest is in its great antiquity, and its widely spread use in so many different religious systems. It still flourishes in the East as a religious symbol, and is used over a very wide area.

L. ALMA TADEMA, R.A., *Hon. Associate.*—I have very few remarks to make. Perhaps Mr. Penrose is not aware of two bronze frames measuring, according to my memory, 2 feet by 2½ feet, one of which had small pieces of window-glass remaining, which I saw about two years ago in the museum at Naples. I am extremely glad to find that we have found some more window-glass here in England, and I wish the explorers much luck.

* This device is denominated "*the fylfot*" on the authority of some ancient directions for the execution of two figures in painted glass apparently of the latter part of the 15th century, preserved in Lansdowne MS. 874. These consist of rude sketches of the figures of a gentleman in armour, with emblazoned tabard, and his lady, who bears on her gown the arms of Cornwallis, she being the daughter of Sir Thomas Cornwallis, and married to Francis Frosmere. Under his wife he directs to be placed "*the Katteryn whele,*" which is in allusion to her Christian name; and of himself he says, "*the fylfot in the nedermost pane under ther I knele.*" . . . It occurs on very early Christian remains, and is found on the girdle of a priest of the date, A.D. 1011. On brasses of ecclesiastics, it is common from the time of Edward I. to the end of Edward III.'s reign, after which no example is met with. One of the latest instances of its occurrence is in a picture by John Van Eyck, preserved in the Musée at Antwerp, where it appears on the stole of a priest alternately with a cross-patée, date the middle of the 15th century. It is found also as an heraldic charge in Harl. MS. 1394, among some arms of Yorkshire families, viz. argent, a chevron between three *fylfots* gules, the name Leonard Chamberleyn. It is called by Randle Holme a cross potencé rebated recoursie.—"*Monumental Brasses from the* 13*th to the* 16*th centuries.*" Drawn and engraved by J. G. and L. A. B. Waller, Lond. 1842. fol.

S. J. NICHOLL, *Associate*.—The Roman pavement I uncovered at Oldcotes near Worksop, in June, 1870, was but a few inches below the surface of the turf; the design included a labyrinth with a figure of Theseus in the centre, all the tesseræ being formed from stone found in the neighbourhood, of grey, white and red tints. Tiles similar to those exhibited, fragments of glass and of charred wood, were also discovered. From fragments of plastering on concrete adhering to tiles, and from the section of the base or plinth which remained in other rooms, it appeared that plaster floors with coloured decorations had been employed.

THE PRESIDENT.—We, as architects, feel very great interest in all discoveries of this nature, and we shall endeavour quietly, and when the full facts are arrived at, to pronounce upon the character of the building of which this is no doubt the first portion; it would be premature, with the very limited discoveries that have yet been made, to attempt to pronounce upon the extent to which it is likely the excavations may be carried successfully. But there are indications here, to my mind, of a very important character; the size of the rooms, the nature of the pavements, the objects that we have here present, permit us to infer that the further excavations now in progress will lead eventually to great results. It appears to me that these matters could not possibly be in more diligent and careful hands than they are; and I trust that, before long, members of my profession will be able to give some interesting account of the character and use of the buildings unearthed.

MR. F. G. HILTON PRICE, F.G.S.—The pavements were found at a depth varying from 3 to 4 feet, whereas the tops of the walls were in certain instances not more than 1 foot below the surface. The majority of the floors of the chambers, not having a tessellated pavement, were covered over with a kind of coarse cement or concrete. With regard to the glass which appears to contain similar ingredients to English window-glass, it was found lying upon the floor of the room No. XVII, with Samian and other examples of Roman pottery above it. In my opinion the villa dates from the 4th century. Early in the 5th century, during the reign of Honorius, the Roman Legions were withdrawn from Britain, and it is probable that the occupants of these buildings removed all their valuables and abandoned the place, first perhaps setting fire to it, as charred remains have been dug up in many parts.

*** Mr. F. G. Hilton Price writes to the Secretaries, on the 30th September, 1881:—

At a distance of 50 yards or so from the entrance to the main building, in a south-easterly direction, we have just unearthed the remains of a structure of great interest, consisting of a chamber, 11 feet 7 inches square, which had been heated by a hypocaust, the soot still adhering to the walls and floor. In the north-east corner two flues still remain perfect, and were at the time of discovery free from all débris; on the north side is the entrance to the furnace. This chamber was filled up completely with mortar and wall plaster mixed with charcoal. On the south side, near the horizontal flues, is what I take to be an oven or kiln, built up of stones, but without much foundation, it being based upon the ruins of an older building. This chamber is contained within a large one, 37 feet by 26 feet, the walls of which are on a higher level, and in it, opposite the aforesaid oven, is a stone base, 21 inches square, for a pillar; then another oven and a second stone base, 17 inches square, for a pillar. Mr. Fergusson was present while a part of this interesting excavation was carried on, and he concurs in the opinion, expressed by Mr. Roach Smith, that our discoveries at Morton point to the probability of a commercial station, or to use the Anglo-Indian phrase, a factory, having existed in and around Brading, which, in Roman times, possessed without any doubt a safe and commodious harbour.

THE SVASTIKA SYMBOL.

[From " Archæological Notes," by Mr. M. J. Walhouse, late M.C.S., in the *Indian Antiquary.*]

" The extraordinary frequency with which the Svastika symbol appears on the Trojan prehistoric pottery gave occasion to Dr. Schliemann obtaining a remarkable and striking communication from the distinguished Orientalist Émile Burnouf, author of the '*Science des Religions*,' &c., which he prints in the earlier part of his book. M. Burnouf holds that this mysterious and much-debated symbol is intended to denote the invention of the fire-drill, and preserve the sacred remembrance of the discovery of fire by rotating a peg in dry wood. It represents, according to him, the two pieces of wood laid cross-wise, one upon another, before the sacrificial altar, in order to produce the holy fire. The ends of the cross were fixed down by arms, and at the point where the two pieces are joined there was a small hole in which a wooden peg or lance (*pramantha*, whence the myth of Prometheus the fire-bearer) was rotated by a cord of cow-hair and hemp till the sacred spark was produced. The invention of the fire-drill would doubtless mark an epoch in human history. Mr. Tylor, in his *Early History of Mankind*, has largely shown its use at some period in every quarter of the globe, and it is conceivable that its invention would be commemorated by a holy symbol. But Mr. Hodder Westropp altogether discredits the origin assigned to the symbol by M. Burnouf, and considers the Greek archaic cross, as he terms it, to have been evidently derived from the punch marks on early Greek coins, which marks were originally composed of four small squares, ⊞, the centre assuming the form of a cross ; but in the stamping of the coin the squares went a little on one side, and made the punch mark take the shape of the archaic cross found on old Greek coins, and thence adopted as an ornamental device on early Greek pottery, as in Samos, Cyprus and Hissarlik. Mr. Westropp goes on to remark that the Indian or Buddhist *svastika* is almost invariably drawn ,卐 the reverse of the Greek archaic cross, and is a monogram or character composed, as General Cunningham has pointed out, of two Pâli characters, signifying 'it is well.' As a Buddhist emblem it cannot be older than the 6th century B.C., Buddha having died about 480 B.C., and the earliest Buddhist monuments are placed by Mr. Fergusson at about 250 B.C. There appears, however, reason to think that on the first appearance of the symbol in Europe it was used not merely as an ornament, but as an emblem peculiar to some deity, generally connected with the air, or sometimes water ; Mr. Newton of the British Museum designated it the Mæander, and considered it emblematical of water. Its first appearance is on the pottery of archaic Greece, as on that in the British Museum ascribed to between the years 700 and 500 B.C., and now on that disinterred by Dr. Schliemann on the site of Troy. On all this pottery and on its earliest examples the sign occurs profusely, and is found drawn *both* ways, occurring so on the same archaic Greek urn in the British Museum ; hence the distinction made by Mr. Westropp between the Greek and Buddhist forms hardly seems tenable, especially as it is found drawn both ways in India, as well as all over Europe. As an emblem it appears to have been associated with the Sky-god Zeus, the chief deity of the archaic Greeks, and to have symbolized his thunderbolt, as subsequently in Scandinavia it was called the hammer of the Thunder-god Thor,—nor is this the only indication of a common origin of the early Greeks and Norse. After the 6th century it disappears from Greek earthenware, and is found on early Latin, Etruscan and Sicilian ornaments, coins and pottery, as well as in Asia Minor and North Africa, especially where there had been Phœnician colonies. It is remarkable that the symbol is not found on Egyptian, Babylonian, or Assyrian remains : crosses are frequent, but not the *svastika ;* neither does it occur on Mexican monuments. In the museums of Sweden and Denmark there are several hundred gold *bracteates*, which appear to have been worn as amulets or medals, and, according to Professor Stephens of Copenhagen, belong almost without exception to the heathen period of Scandinavia, ranging from the 3rd or 4th to the 7th or 8th century of our era. They are mostly after Byzantine models, and many of them have a marked Indian character. They frequently bear the *svastika*, drawn both ways, and Professor Stephens remarks that in the earliest runes the letter G is drawn thus 卐, and appears so on grave-slabs in Denmark of the 8th or 9th century. He also calls attention to the resemblance between the runes and the Himyaritic alphabet, used in Arabia during the first six centuries. A character nearly resembling the runic G, occurs in a Pâli inscription, and reversed in a rock-inscription at Salsette : see *Journal Royal Asiatic Society*, vol. xx. p. 250, &c. In the Roman Catacombs the *svastika* occurs not unfrequently, so placed as to have been then evidently adopted as a Christian symbol, and is seen in Roman mosaic work in England, France, Spain and Algeria. It is abundant on pottery, ornaments and weapons of Romano-British and Anglo-Saxon times, and of corresponding periods in Scotland, Germany, Switzerland and Denmark. A sepulchral urn found at Shropham, Norfolk, and another preserved at Cambridge, bear the *svastika* in continuous lines ; the latter urn is peculiarly interesting as exhibiting the symbol surrounded by almost every other device of cross, circle and solar

emblems, and occupying, as it were, the place of honour. As Christianity spread the *svastika* disappears, and when found again has been adopted as a Christian device. . . . . But, whatever may have been the origin of this most archaic and wondrously wide-spread symbol, there seems little to support the theories of Messrs. Émile Burnouf and Westropp. Mr. E. Thomas (*Journal Royal Asiatic Society, N.S.* vol. i. p. 486), thinks it may have been a mere ornamental variation of the simple cross, that might have suggested itself anywhere, without any definite meaning, but singular enough in outline to attract professors of magic and cabalistic rites. Still this hardly explains its adoption in countries so widely separated as Norway and Japan and its strange defect in the far older intermediate lands of Egypt and Mesopotamia, the very nurseries of magic and mysticism."

COINS (MOSTLY OF THIRD BRASS) FOUND DURING THE EXCAVATIONS.

DOMITIANUS (Denarius), A.D. 81-96.

DOMITIANVS. CAES. AVG. F., *rev.* IMP. XXII. COS. XVI. CENS. P.P.P. ; female figure.

HADRIANUS, A.D. 117-138.

ANTONINUS PIUS, A.D. 138-161.

FAUSTINA, Senior, A.D. 138-141.

SEVERVS ALEXANDER, A.D. 221-235.

IMP. SEV. ALEX.

ELAGABALVS (Denarius), A.D. 218-222.

rev. PROVIDENTIA. AVG.

TRAIANVS DECIVS, A.D. 249-251.

IMP. C. M. Q. TRAIANVS. DECIVS. AVG. *rev.* two s standing, holding between them a military ensign. PANNONIAE.

GALLIENVS, A.D. 253-268.

Rev. CONS. AVG., a centaur, Z in exergue ; DIANAE. CONS. AVG. ; a stag.

SALONINA, Wife of Gallienus (Denarius).

SALONINA. AVG. ; female figure standing, shield on left, holding palm branch. *rev.* VENVS. VICTRIX.

VICTORINVS, A.D. 265-267.

IMP. C. VICTORINVS. P. F. AVG. SALVS. AVG. Hygeia, standing, holding a patera and serpent. PIETAS. AVG.

TETRICVS, Senior, A.D. 267-272.

IMP. C. TETR. *rev.* a woman standing holding palm branch and cornucopia.

POSTVMVS, A.D. 258-267.

SERAPIDI COMITI AVG. Serapis standing ; SAECVLI. FELICITAS., the sun.

CLAVDIVS GOTHICVS, A.D. 268-270.

DIV. C. L.; *rev.* an eagle.

SEVERINA, Empress of Aurelianus.

ALLECTVS, A.D. 293-296.

IMP. C. ALLECTVS. AVG.; *rev.* LAETITIA. AVG. a galley, with a mast, and six rowers, in exergue Q. C.

LICINIVS, Senior, A.D. 307-324.

rev. GENIO. POP. ROM. In the exergue, T. R., Treves.

CONSTANTINVS, A.D. 307-337.

SOLI. INVICTO. COMITI. Treves.

CONSTANS, Son of Constantine Max., A.D. 333-350.

FL. LVL. CONSTANS. NOB. CAES. *rev.* GLORIA. EXERCITVS. two military figures standing, between them a standard ; D. N. CONSTANS. P. F. AVG., *rev.* a phœnix standing on a rock ; FEL. TEMP. REPARATIO. in exergue CONS ?

CRISPVS, A.D. 317-326.

CONSTANTINVS II., A.D. 337-361.

MAGNENTIVS, A.D. 350-353.

1. *Rev.* FELICITAS REIPVBLICAE. Magnentius, standing, wearing the paludamentum ; in his right hand a victory, in his left a labarum, with the monogram of Christ ; in the field A, in the exergue T. R. S.
2. *Rev.* GLORIA. ROMANORVM.

VALENTINIANVS, A.D. 364-375.

VALENS, A.D. 364-378.

GRATIANVS, A.D. 375-383.

HONORIUS, A.D. 395-423.

V. PERSIAN ARCHITECTURE AND CONSTRUCTION.

BY MR. C. PURDON CLARKE AND PROFESSOR T. HAYTER LEWIS, F.S.A., *Vice-President.*

[Read on Monday, 31st January, 1881, John Whichcord, F.S.A., *President,* in the Chair.]

THE objects of art, and most of the drawings which illustrate this Paper, were lent to me by Mr. C. Purdon Clarke, who was for some two years employed by the Government as Resident Architect to the British Embassy in Persia, and who is now in India on a mission from the authorities of the South Kensington Museum. To him I owe the constructive details and also many suggestions of value respecting the theories of the formation and influence of Persian and other Eastern art.

I am afraid that, to many of our Members, the subject will not have much interest, inasmuch as it may seem to be but remotely connected with our present work. To me, however, the study has served as a relaxation from the hard work of ordinary professional life, as it appears to be the source of the new and grand outlines practised by the Byzantines, and now, in various styles, homely forms to us. The dome, for example, not springing timidly, as we may say even of the great Pantheon of the Romans, from a circular base built solidly up from the ground, but raised high in the air on four great arches, the angles of which were gathered up into pendentives to form a base, high above, for the dome that was to cover all.

To Persia, too, whether under its various conquerors or its native race, we owe, so far as I can gather, that singular form of pendentive, the honeycomb—one of the distinctive features of Arab art—and many, if not most, of the beautiful ornaments of tile work; incised marbles and other refined decorations, which give so great a charm to Byzantine and Arabic work. Through Byzantium, Egypt, Spain and Venice, Persian art deeply influenced mediæval work, in Italy, Germany and France, and not until the rise of pure French and English Pointed Architecture did this influence pass away. It affected us again in later times. When we look upon the dome of our St. Paul's cathedral, when we consider the decoration best fitted for it, and envy, perhaps, the skill of Sir Christopher Wren, it will be well to remember that some 1,300 years ago the same form was built up, in a bolder way, and its surface decorated by the Byzantines, in a manner which we are now only trying to imitate; and that these same Byzantines worked, so far as I can learn, after the hints supplied to them by the Persians. The history of this latter nation is unique, as theirs is the only one of the great monarchies of antiquity which has lasted, though with fitful intervals, down to the present time, when their art, like their power, is in decay. And yet, considering its long duration and its fame, we know wonderfully little of it. Persia is well nigh closed-in on the east by a chain of desolate lands, and on the west by the great Syrian desert. To the north are the Tartar tribes, and the almost desert Sea of the Caspian; whilst in the south, the Persian Gulf and the wild tribes near it, make the visits of travellers far between. Nearly all, in fact, that we know accurately about it, from personal investigation, is derived from Sir R. Ker Porter, Texier, Flandin and Coste, and such memoranda as have been obtained from residents in Persia. We all know the valuable essays which Mr. Fergusson has worked out in his *Handbook* and also in his *History of Architecture* from these materials. He has told us that

there is no hiatus in architectural history more complete than that which occurs in Central Asia during the ten centuries from Alexander to Mohammedanism; and still further, that the architectural history of Persia is a complete blank for the first six centuries after the Hegira. This was no doubt written before the unexpected discovery of the Palace at Mashita, in Moab, which revealed to us quite a new phase of Persian art; but if the date which he assigns to it—namely, that of Chosroës—be correct, his statement still holds good.

Now, in endeavouring to give a slight sketch of Persian work, we must remember that the kingdom covered very different tracts of country at different times; that it has been conquered and permanently colonized at various times by Greeks from the west, Arabs from the south, Tartars from the north, and Turks from the north-west, and that it lay in the great route of trade between Europe, India and China. We have now to see what we can learn of native Persian art in its earliest phases. I purpose, therefore, to give a slight sketch of the influence upon it by foreign nations, and the influence which it brought to bear in return upon them, and to describe (chiefly from notes, most kindly supplied to me by Mr. Clarke) the present style of design, modes of planning and construction; and manners and customs are so unchangeable in the East, that we may fairly well expect to find in the work of the present day a strong reflection, at the least, of the artistic and constructive work of times long since past.

The influence which the art of Assyria had upon that of Greece is too well known to require me to detain you about it. Modified, chastened and resolved into the beautifully-delicate forms which the Greeks gave them, the Assyrian architecture and ornaments have influenced all art since, throughout the western world. As the historian Niebuhr says:—"*There is a want in Grecian art which no man living can supply. There is not enough in Egypt to account for the peculiar art and peculiar mythology which we find in Greece. But the time will come when those who live after me will see, on the Tigris and Euphrates, the origin of Grecian art and Greek mythology.*"* It was many a year after this, that Layard and Botta had the happiness of verifying this forecast of the historian.

Of Persian architecture in its grandest forms, before the conquests of Alexander, we have clear existing evidence in the remains of Persepolis and Susa. But the domestic buildings, many of which, as recorded, must have been of great size and splendour, we know only by description. We are told that the great mansions had courts, surrounded by colonnades, whose pillars and beams were of cedar or cypress, sometimes coated with precious metals; that wood was used to a large extent we may also infer from the account of the destruction of Persepolis by fire. That gorgeous colouring was used we know from Herodotus, and that the paving was equally grand we know from Esther (a contemporary), who is supposed to be describing the palace at Susa, now in ruins, and says:—"*The king made a great feast in the court of the garden of the king's palace. The beds were upon a pavement of red, blue, white and black marble.*"† Now this was long before Alexander's time, and there is nothing in it to remind us of Greece, or Assyria, or Egypt, or of any other art with which we are acquainted. But the Ionian colonies brought the Greeks into constant communication with Persia, and thus repaid her the debt which the Greeks formerly owed to her provinces on the Tigris and Euphrates.

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* See the *Quarterly Journal of Science*, 1865, page 726.

† See the *Book of Esther*, Chap. 2, v. 5-6.

The conquests of Alexander, also, were not mere invasions, but were secured by the building, on the most defensible sites, cities, which he peopled with inhabitants, mostly Greek. Thus, on the farthest part of his dominion—namely, the Hydaspes (now the Thelum)—he built two cities some 150 miles north of our modern town of Moultan, and not far from the scene of the battle, in our times, of Chillianwallah. Near Cabul he built another (Alexandria ad Caucasum), in which he planted 7,000 soldiers (Macedonians and others). Another near Candahar, two others on the Indus, another in Aria, and another near the modern Merv. But the most remarkable of all was, perhaps, that built at almost the farthest point of his new dominion, north-east of Samarcand (where Clitus was murdered); in this Alexandria Ultima he planted Macedonian veterans and Greek mercenaries, with volunteer settlers from the nations around. That Greek influence was strong, not only in Persia itself, but on the adjoining nations, is shown by many details in the carvings of Indian works of the time of Asoka (*circa* B.C. 250—213), some 70 years after Alexander's death down to the later times of the Amravati Tope (*circa* 4th century A.D.), and by the sculptures which may be seen in Dr. Leitner's collection in the Indian Museum. But that native Persian art still survived under her temporary conqueror is also clearly shown by the direct copies in other works, of the beginning of our era, of the falling leaf, bell-shaped capital, and the double bull or horse capital, from Susa and Persepolis. Both these are clearly shown in the Gateway of the Sanchi Tope (*circa* first century A.D.). On one of the columns of the Amravati Tope we have also as clear a copy as can well be made of the well-known Assyrian lotus leaf and bud.

The dominion of the Greeks lasted until, suddenly, Bactria in B.C. 256, and Parthia in B.C. 250, became independent. The new Bactrian monarchs, who also ruled in Cabul and Western India until B.C. 120, were Greeks, so that the customs of their country underwent no violent change. But the Parthians, though their ancestry is unknown, were of an entirely different race: Turanians, nomads, unused to cities, leading a wandering life, and when settled scarcely attached to the soil as natives. Professor Rawlinson compares them to the Osmanli Turks, and though they built one noted town, Dara (whose site is even now unknown), they have left but little trace of their architecture or sculpture. The only well-known building which is thought to be their's, is Harda or El Hadhr, no great way south of Mosul. The description is given fully by Mr. Ross,* and is shortly described by Mr. Fergusson, who assigns to it a date certainly before Constantine; and Professor Rawlinson, a later authority writing in 1873, gives the date as A.D. 150. But whether during the time of the Parthians, or soon after it, it represents, no doubt, the debased art of Persia of the second and third centuries of our era; and beyond these few remains we have nothing on which to rely.

In Trajan's time (*circa* A.D. 116) there was founded a Roman colony at Nineveh, and the old province of Mesopotamia became Roman.

The grand ruins of El Jerash (the ancient Gerasa), in the almost uninhabited land of Moab, show how magnificently the Romans adorned the countries at the farthest limits of their empire, and give us an idea of how far they must have influenced the arts of neighbouring countries also. After about 470 years of Parthian rule, the native Persians revolted, in A.D. 220; under the Sassanians, they drove back the Romans, and (*circa* A.D. 540) reigned in Persia, Syria and Egypt. Again there is a blank in the history of their architecture, the great buildings of their

* Vol. IX. of the Geographical Society's Journal,

reign having comprized, until recently, little more than some remains at Ferozabad, the date of which, according to Mr. Fergusson, is *circa* A.D. 350; Serbistan, east of the Persian Gulf, about A.D. 450; and Ctesiphon, far away to the west, near Baghdad, the date of which is given by Mr. Fergusson as *circa* A.D. 550, but no documentary evidence exists as to this, and the town itself was founded in earlier times, as we know from Pliny and Strabo. These remains are, indeed, few but very interesting. The old Persian doorways at Persepolis are reproduced almost exactly at Ferozabad; at Ctesiphon and at El Hadhr the halls were reproduced on a grander scale; and at Ferozabad and Serbistan we find, for the first time, so far as I know, the circular dome carried up from a quadrilateral base, thus enabling the architect of the then future to carry out varied, bold and beautiful outlines—the dome, the minaret, the tower, the spire—untrammelled by the form of the base from which they started.

Whether the Greek architects who designed St. Sophia, and thus brought Byzantine work to take, at one step, a grand position in art, had exact precedents in Persia for their work I cannot say. But we clearly owe to the Persians the mode of lighting by small star-like holes through the domes or vaults. If Victor Place's opinion be correct, this originated with the Assyrians, as shown by their great palace at Khorsabad; but the architects of Serbistan reproduced it, and it is to the present day a common and very beautiful mode of lighting.

One other building has been left to us by the Sassanians, namely, that discovered at Mashita in Gilead, by Sir H. Layard, in 1839, recently well described by Canon Tristram, and thought by Mr. Fergusson to be a palace of Chosroës, and thus built at about A.D. 614. Good photographs of it have been privately published, and make us deeply regret that we have no more remains to guide us as to the peculiar style there shown. Mr. Fergusson's suggestion is that it was erected by Byzantine workmen under a Persian architect, and from his great knowledge it is a very serious matter to differ from him; but I venture to suggest that the full-bodied capitals found at Mashita have their prototypes in the Sassanian buildings at Bisoutoun and Ispahan, whereas I know of none of so early a date in the more western parts of Asia under Byzantine rule.

The Persian native empire of the Sassanians was overwhelmed, a few years after, by the Arabs (A.D. 641), who established their capital at Baghdad. But even they have left few traces of Saracenic art, although Haroun-al-Raschid (A.D. 786—808) was an enlightened monarch, and his court was the resort of men of art and learning; and Mahmoud (A.D. 977—1030) was celebrated alike for his magnificence and warlike deeds, and ruled as conqueror from Georgia to Baghdad, Bokhara, Kashgar, Ghuzni and the Deccan. The paucity of remains may be accounted for by the exterminating policy of the next swarm of invaders—the Monghols. They first invaded (*circa* A.D. 1218) Bactria. Before their appearance the great towns there were rich and powerful, emporiums of trade with India and China, though the details of their history are little known. But it is certain that Bokhara, Khiva, Balkh, Herat, Merv and Samarcand, towns of which we now hear so much and know so little, were great and prosperous to a degree, of which their present state exhibits scarcely a trace. Samarcand is described as then being one of the greatest entrepôts of commerce in the world. All these are said to have been burnt, utterly destroyed and swept away, by Ghengis-Khan (A.D. 1206—1227). Under Holaku, in A.D. 1242—1272, Persia shared well-nigh the fate of Bactria. Baghdad was captured in A.D. 1258,

and, with Aleppo, Damascus, and other great towns, was stormed and sacked. In A.D. 1294, the Persian Monghols became Mohammedans, and then, it is supposed, began the list of the splendid buildings of that religion under their rule. But the famous Timour (Tamerlane), A.D. 1370—1405, again over-ran the western part, then in a complete state of anarchy; and the great historical towns of Ispahan, Baghdad, Aleppo, Damascus, Boursa, Smyrna, &c., again became scenes of destruction. Yet Timour is celebrated by all historians as a man of cultivated mind, speaking Turkish and Persian fluently, and delighting to converse on history and science. His capital was Samarcand.*

I have dealt somewhat at length on this subject, because, first, it seems to account for the small remains which the great towns of Persia have left to us of their former greatness; and, secondly, because the works of these destructive Monghols are further instances of the extraordinary manner in which new forms of art have, throughout the world's history, arisen. The Monghols were not a semi-civilized race like the Parthians. They came fresh from the Tartar steppes, a nomad race—shepherds—without fixed habitations, even for their kings; altogether wild, uncouth destroyers of the towns which they conquered. Gibbon's splendid chapter upon them will be remembered by all. And yet these savage destroyers seem to have been the parents of what architecture we have in Persia, except the few remains before cited. Had they any characteristic art, or any art of any kind, in their native steppes? None, so far as we can judge.

Just so it was with the Arabs: they burst suddenly as wild though not so destructive as the Monghols, from their native deserts, over-ran all the countries from India to Spain, and stamped upon them the peculiar art which we know as Saracenic. No one could mistake it, although now so perishing, and yet I doubt if, at the beginning, they had more native art than the Monghols.

I have gone painfully through the Koran, and in all its flights of imagery, I can find nothing which gives the notion that its author had seen, in the buildings of his native Arabia, anything beautiful, or noble, or grand. Is not the same phenomenon witnessed in the inroads, and the architecture, of the sea kings of the north, which gave us our "Norman"? And again, it leads us to think in what manner this formation of new distinct styles took place at various times. Take Rome as an example: she had to get all the details of her architecture from decaying Greece, and yet she formed, in a comparatively short space of time, a style borrowed indeed from Greece, but so made Roman in all its details that, whether found in Britain or Italy, or north Africa, or Spain, or Persia, we can say with no doubt in our own minds that it is Roman, and none other.

To return to the works of the Monghols: however their art was acquired, we must take the ruined Mosque of Tabreez, the date of which is not known, but it is given by Mr. Fergusson as A.D. 1294 (or later), and by Texier as A.D. 1450-80, and the grand deserted tomb at Sultaneyeh, the date of which is assumed by Mr. Fergusson as being A.D. 1303-16, but by Texier, who drew the building on the spot, as 250 years later. Tabreez is in ruins, but Sultaneyeh still remains, well nigh perfect, and is one of the most beautiful

* It may be worthy of note, as given to me on very good authority, that when the Russians captured the town recently, they had good photographers ready, and within two hours after the capture these photographers were hard at work on all worth copying.

examples of decoration that exists. Both are brilliant with glazed tiles or enamelled bricks, of beautiful make and design, and except the Alhambra, the Mosque of Omar, and the buildings of India which I have not seen, are probably the finest examples of their use extant.

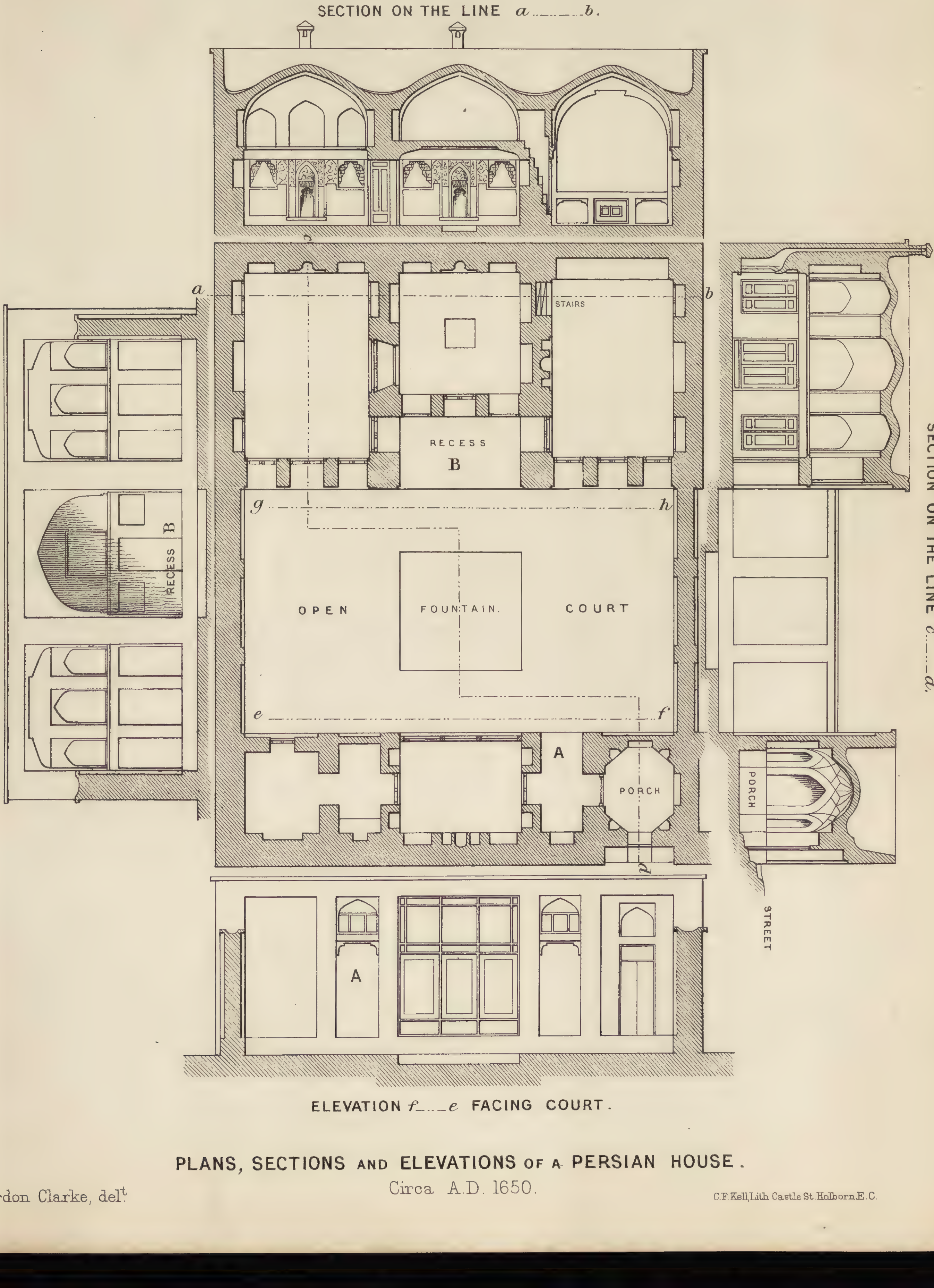
The use of that splendid decoration, of which some grand examples are given in Victor Place's work on Khorsabad, "was continued (I quote Dr. Birdwood's words) in unbroken tradition from the time of the Chaldæan monarchy—fell into comparative disuse before the rise of the Saracens—and then by the conquest of Ghengis Khan (A.D. 1206-27) appears to have been brought again into general use in Mohammedan countries." I need scarcely mention that the grandest example of their use in Europe is the Alhambra, dating from A.D. 1309-1354 (?). Another singular instance is this, of the spread of art by the Monghols. That they did not originate this tile work, or the still more beautiful mosaic work found at Teheran and other places, is certain, inasmuch as tiles are found of the date A.D. 1072, and fine remains are found in the ruins of the well known city of Rhages at the confines of Parthia, which was destroyed in A.D. 1250 and never rebuilt. The art seems to have died out in the 17th century, with Shah Abbas (A.D. 1583-1629) to whose reign is assigned the Great Mosque at Ispahan. Of about the same date are the fine series of panels in the Persian Court of the South Kensington Museum, which were saved from destruction and brought over here by Mr. Purdon Clarke.

I have now to bring before you a statement of the actual mode of constructing houses in Persia, which seems, from the familiarity of the workmen with some of the most difficult parts, to have been in use for centuries. The drawings which Mr. Clarke has supplied, and which I take as my text, are the ground plan and sections of a Persian house* built in 1650. It has the open court which answers in some measure to the Roman atrium, but the disposition of the whole plan is unlike the Roman. Roughly speaking it consists of a long open court with rooms, &c. on the two long sides. The entrance is at the end of the rooms next to the road, through a small but very pretty octagonal hall, somewhat unusual, on plan, and with a peculiarly groined roof, the design being described to me as like that of Beejapore which was illustrated here, years back, by Mr. Fergusson. Out of this hall you turn sharply to the left into a passage which leads sideways into the court. By this sudden turn, the privacy of the house is quite protected—an object which, I am sure, ought to be borne in mind more than it is in our own plans. In the centre of the court, which is paved with square tiles, is a square sinking for water and fountain. On the side opposite to the entrance are two rooms and a kitchen. There is an upper storey over some of the rooms, but in general, they are ceiled only by the roof.

In planning such a house, the Persian architects use paper which is ruled crossways in faint lines, as sometimes used by our engineers, the divisions representing the ordinary thickness of the walls, so that an architect, who does not care to spend much trouble about a plan, has merely to draw his brush roughly through these squares and the workmen knows just what is wanted. I need scarcely say that this method of working gives a sort of rhythmical proportion to all the rooms, &c. and materially assists in continuing the rectangular system of planning, which has so especially characterized Eastern art from Egypt and Assyria downwards. But the exquisitely beautiful manner in which, in the East, the square form is

* See Illustration No. 12, lithographed from a sketch made on the spot by Mr. Purdon Clarke.

PERSIAN ARCHITECTURE AND CONSTRUCTION. (Nº 12).



PLANS, SECTIONS AND ELEVATIONS OF A PERSIAN HOUSE.

Circa A.D. 1650.

C Purdon Clarke, del[t]

C.F. Kell, Lith Castle St. Holborn E.C.

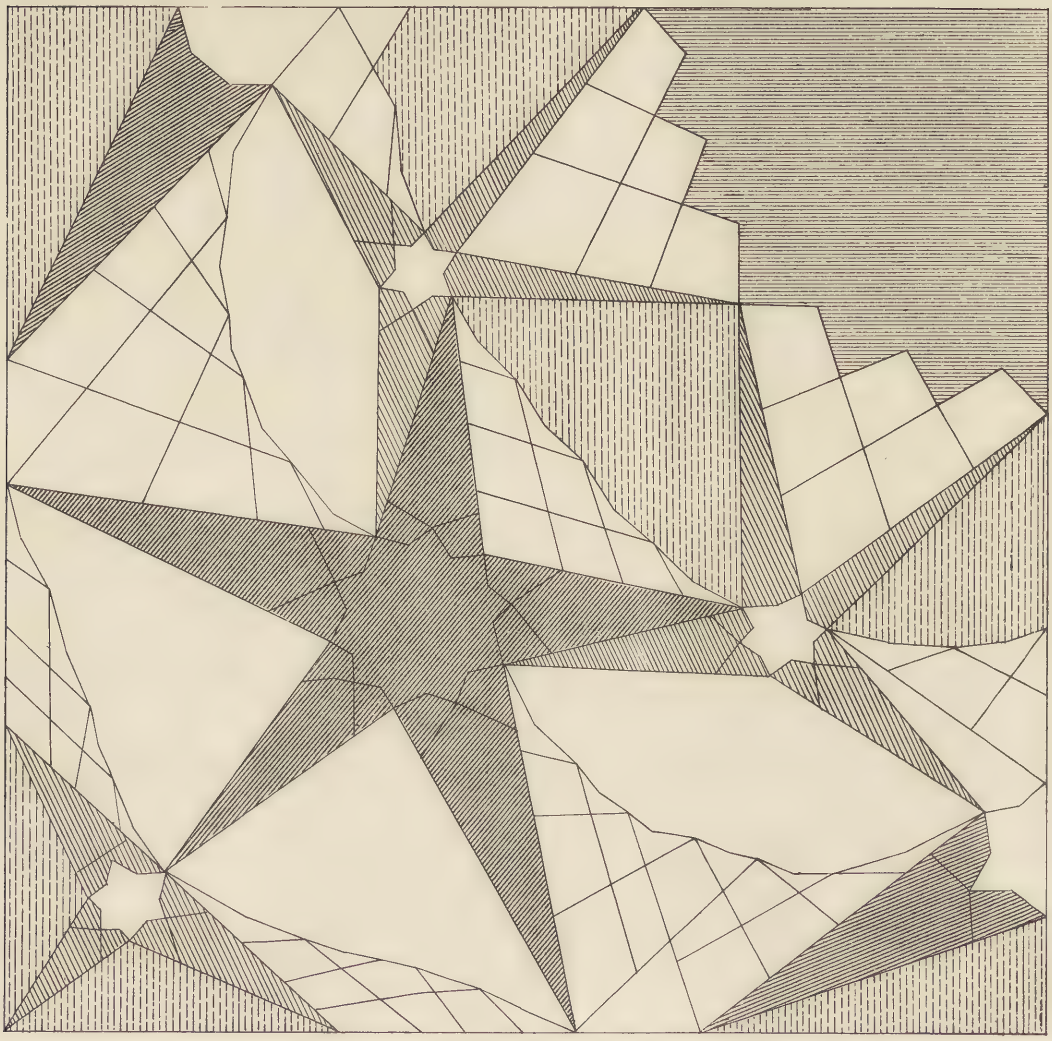
that he was obliged to do much of the modelling himself, from the absolute impossibility of getting the most skilful workmen to understand its intricate details. I know from my own experience, that to draw one of these complicated pendentives is about as difficult a piece of work as well can be found. I think that I am not wrong in saying also, that one of our Fellows, who has given great attention to the subject, was engaged for two hours, lying on his back, under a portion of this honeycomb work at the Alhambra in Spain, before he could obtain a plan of it to his mind—and that, furthermore, he himself was quite unable to understand that plan the day afterwards. I feel bound, myself, to say that I entirely enter into his feelings; and yet, such is the habit which these Persian workmen have acquired, by long tradition and habit, of carrying out this work, that they are able to work out the most intricate patterns merely from such plans as you see roughly drawn on the green paper. The work is always applied—never constructive—and is built up of a number of small pieces of wood, the joints being so arranged in the pattern as not to be noticed. The illustration No. 13 will serve as an example of the whole. Next in point of decoration are the windows, formed of plaster work, in the most beautiful patterns, the chief being that of a slender central stalk, branching out into delicate conventional forms. The effect is, of course, that of a screen, not a window, keeping out the fierce rays of the sun, and when fitted with coloured glass, like those specimens before you, producing a most beautiful effect. The fragments of windows, which I exhibit, formed part of a building about to be demolished, when the Shah made a present of them to Mr. Clarke. The doors are equally ornamental, and you have two examples before you, lent by Mr. Clarke; they are made of small pieces of wood, much as I described* those which I drew at Algiers.

I now come to the painting, &c. A large part of the lining of the walls is of wood and this is prepared for painting in a very peculiar way—somewhat as I described that to the ceiling of Kait Bey's tomb at Cairo. The flat boards are covered over with a coating of rough hemp cloth, soaked with a kind of gesso, which forms a body for a thin layer of this delicate plastering, on which the painting is done. The cloth conceals, of course, any defects in the wood from shrinkage, &c., but each board is coated separately and the cloth returned round the edges, so that the shrinkage at the joints is almost as prominent as with us. The tone of the gilding will strike one, at once, as peculiar—a good specimen of it may be seen in the room from Damascus now at the South Kensington Museum—there is seldom any real gilding, the effect being produced by a delicate kind of gold size. This can be coloured with a reddish or greenish tint at pleasure, and the result, when skilfully done, is a very charming variety of gilded tints, none glaring nor so brilliant as to destroy any neighbouring decoration.

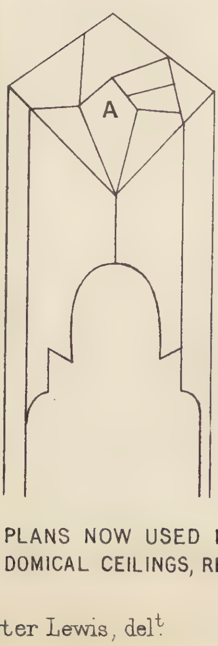
I have now only one more subject to which I will call your attention, namely, some of the *forms* of the Persian decorative work. I have already alluded to Mr. Clarke's opinion, that many of the most characteristic of its forms were derived from the Tartars or Chinese—perhaps from Tartar-Chinese art—one notably so is the bulbous dome. These forms serve as the main outlines to a large part of Persian decoration, and, so far as I can learn, were quite unknown before the Monghol invasions, and at which time it is recorded

* See Professor Lewis's *Notes on the Celtic, Roman, Moorish and other remains in Algeria*, in the TRANSACTIONS, 1868-69.

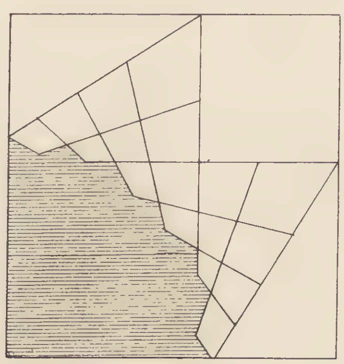
PERSIAN ARCHITECTURE AND CONSTRUCTION, (Nº 13.)

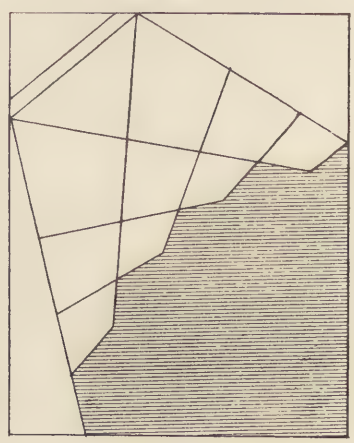


NOTE. *The hatched parts are not in the Original.*



A. THE END OF A SMALL STALACTITE NICHE HEAD SHOWING THE SEPARATE PIECES OF WOOD OF WHICH IT IS FORMED.





PLANS NOW USED BY ARAB WORKMEN FOR FORMING THEIR COMPLICATED NICHE HEADS & DOMICAL CEILINGS, REDUCED FROM WORKING DRAWINGS IN THE POSSESSION OF MR. C. PURDON CLARKE.

T. Hayter Lewis, del.t

C.F. Kell Lith. Castle St. Holborn. London E.C.

that numerous Chinese workmen came to Persia. One is, of course, apt to think of Chinese art as represented by the monsters familiar to the last generation, the taste for which Oliver Goldsmith satirized in his Essay. But I need scarcely say that some of the old Chinese decorative work, in enamel and otherwise, was very beautiful. In the Persian Court at South Kensington, for instance, are two small tiles, each with a female figure drawn on it surrounded by flower-work. The figure is distinctly Chinese and poorly drawn, but the flower-work is as beautiful as, I suppose, any work of the kind existing. At South Kensington there is also a very fine vase, covered with cloisonné enamel of the most exquisite kind, which serves very powerfully to support Mr. Clarke's idea; it is dated, and of the fifteenth century at the latest. I have drawn a small portion of it to a large scale and, as a companion, have drawn part of a Persian tile of the seventeenth century. The latter is very roughly done, whereas the Chinese is of extreme delicacy, so that the one is a mere rough rendering of the other. But that the Persian seventeenth-century tile *is* a rendering of the fifteenth-century Chinese one, can, I think, scarcely be doubted.

To conclude this sketch, which has grown to a much longer extent than I intended or wished, I will venture to say that in Persian art we find outlines, colouring and decorative work, which have formed the bases of many of the most beautiful architectural forms handed down to us by the Byzantines and the Arabs.

JAMES FERGUSSON, F.R.S., *Past Vice-President.*—While complimenting Professor Lewis on the learning and industry displayed in the Paper which has just been read, I cannot help feeling that it is somewhat of a mistake to attempt treating so vast a subject in a single Paper. During a period extending over more than two thousand years, in the countries usually known as Persia, there were at least half a dozen styles of architecture, differing from one another almost as much as any styles in any other country, and each sufficient in itself to occupy an evening, in such a meeting as this, for its satisfactory treatment. It might have been otherwise if Persia had ever been a country with fixed and well-defined limits, and inhabited by a homogeneous people belonging to any one of the great families of mankind, whose affinities have now been ascertained with such precision. The contrary, however, was pre-eminently the case. From the earliest periods of authentic history, we know that the population of Persia was divided in nearly equal proportions among the three great races of mankind. The earliest, and at one time, probably the most numerous division, belonging to the Turanian class; the second comprizing the inhabitants of Nineveh and Babylon, and the countries bordering on them, to the Semitic family; and the last, the conquering race of Persia Proper, to the Aryan division of mankind. To illustrate this, it is only necessary to recall to mind the first three. When Darius engraved his well-known tablets at Behistan, he wrote the first in his own language—the old Persian—closely allied to the Sanscrit; in the second tablet this was translated into Chaldean, as nearly allied to the Hebrew, while the third set of tablets was written in a Turanian dialect, which is now generally called *Akkadian*, differing most essentially from the other two. The same process takes place at the present day. When the Pasha of Baghdad issues an edict, he is forced to follow the same practice, only reversing the order. The first copy is naturally in his own

Turanian Turkish; the second in Arabic, appealing to the Semitic element of the population; the third in Persian—the lineal descendant of the old tongue. It is the mixture of these three races, or the exclusive domination of one or other of them in that country, that makes the study of its architecture so complex and so difficult. As one or other of them became dominant, the architecture, as it always does, expressed its supremacy, and the facility with which the changes in style were wrought, merely expresses how unstable the equilibrium between the three races was in that country, and where frequent revolutions were the result; notwithstanding the difficulty which this complexity introduces into the study of Persian architecture as a fine art, it would render it the most favourable country in the world for the study of the ethnography of architecture, were it not for the unfortunate paucity of examples which now remain. But partly from the ephemeral material out of which buildings are there constructed, partly from the frequent and violent revolutions which have swept over it from time to time, it would be difficult to find any civilized country where monumental buildings, either civil or ecclesiastical, are so few and so far between, as in those regions known under the generic term of Persia. The earliest of the styles alluded to above is that introduced by the Achæmenidæ (B.C. 559 to 331), as exemplified in the palaces at Persepolis and Susa, and is interesting not only from its intrinsic beauty, but because it is a first attempt to repeat, in stone, forms which had, before that date, been used at Babylon and Nineveh only in wood. After existing for a couple of centuries it perished almost entirely, with the dynasty with whom it originated, when it was overthrown by the conquest of Alexander the Great. After this, the architectural history of Persia is an entire blank, during the whole period of the Greek and Roman domination of the country. The latter people covered Syria and part of Asia Minor with splendid buildings, rivalling, if not surpassing, many of those in Rome itself. These extended as far eastward as Palmyra, but nothing of any importance has been found in the Valley of the Euphrates, or in the countries beyond it to the eastward. The Parthians, who succeeded the Romans, did nothing to redeem the barrenness of the record. This one palace at El Hadhr, is a mere congeries of tunnel vaults, of little or no architectural pretentions; and though it is true that the Sassanians (A.D. 223 to 632) did erect some buildings of importance, they are hardly such as would attract much attention, if it were not for the darkness that surrounds them. So far as we at present know, however, the Sassanians were the first—certainly in the East—to use the pendentive dome, which afterwards proved so essential a formative principle in Eastern styles. Whether they invented it or not, is another question, which we have at present hardly sufficient means for answering satisfactorily. But though we cannot trace all the steps by which the Pantheon at Rome, erected under Augustus, became elaborated into the greatest and most perfect of pendentive domes, in that of St. Sophia at Constantinople, erected by Justinian (A.D. 537), we probably know enough to be able to assert that it was an indigenous invention, and that at no stage did the Roman or Byzantine architects borrow any features from the East. The palace at Mashita, though built for a Persian king, Chosroes II. (A.D. 627), can hardly be claimed as an example of Persian architecture. It is found in Syria, far beyond the limits of that empire, and of a style betraying far more affinities to classical art than to anything that savours of the East. The modern architecture of Persia divides itself easily into two very distinct styles. The first is that we know as the Saracenic, elaborated in Cairo and Damascus, and introduced by

the Arabs into Persia after their conquest of that country in A.D. 651. It was the architecture of the Caliphate of Baghdad, and no doubt was as gorgeous and as elegant as almost any of the less intellectual styles that ever existed, but it has the sad characteristic of all Persian styles, that it was ephemeral, in consequence of its buildings having been erected with the perishable materials of a country where neither stone nor marble existed in sufficient abundance to be used for building purposes. All that now remains of the thousand and one buildings in this style are a few tombs, and these by no means the most magnificent of their class. The remaining style of Persian architecture may be classed as the fifth or sixth, according as we admit or deny that any modification of classical art ever existed in that country. It was introduced, or perhaps it may rather be said, was invented by the Tartars or Monghols, who invaded the country in the thirteenth and fourteenth centuries. At first they, of course, employed the Saracenic style they found there, but gradually impressed upon it their own love of gorgeous colouring, and introduced the bulbous dome, which is a characteristic of Tartar architecture wherever these people penetrated. Compared with what the same people did in India, it will probably be admitted that, though the buildings at Ispahan and Teheran are very beautiful, they are surpassed by those at Agra and Delhi, and other places in India. It is, however, to this modern form of Turanian architecture that all Mr. Purdon Clarke's illustrations of Persian art belong, and to which the whole of the latter part of Professor Lewis's Paper is devoted; and it is well worthy of all the attention they have bestowed upon it. Indeed, it probably, as said before, might have been better if the whole had been confined within one subject, which in itself is more than sufficient to occupy this meeting for one or more evenings.

Mr. J. D. Crace.—I should like to call attention to the photographic views of a house, about the date of the one described by Professor Lewis, a house occupied by the English Consul-General ten or twelve years ago in Baghdad. It is a very pretty example of the Saracenic style of that period.* I think, in humble confirmation of Mr. Fergusson's theory, that it is hopeless to trace a direct sequence between the art of ancient Persia and the remains of almost purely Saracenic art which exist in Persia at the present day, and which is much more closely allied with the Arabic or pure Saracenic than with any other. The remains at Mashita, in Moab, afford an extremely interesting link in the history of art, both of Persian art and Byzantine art, and I should like to mention to the Institute that the Palestine Exploration Fund Committee, of which I am a member, are about to undertake the exploration of that side of Palestine which is to the east of the Jordan. It has been explored in a very cursory way by a good many travellers, but never systematically examined, and one may fairly conclude from what is known that it is covered to a far greater extent than Western Palestine with ruins, and those ruins in a high state of preservation. They suffered one general devastation, and from that time have not been altered, as those in Western Palestine have been. I cannot help hoping, therefore, that they may afford very considerable additions to those links of architecture which intervene between remotely ancient architecture and the Roman period. It has been thought that the manufacture of Persian tiles ceased about the middle of the

* See Mr. J. D. Crace's Paper on *the Ornamental features of Arabic Architecture in Egypt and Syria*, in the Transactions, 1869-70. Plans are there given of houses in Cairo and Damascus, built when Arabian art still flourished. The late Sir Digby Wyatt's speech, in opening the discussion on the subject, is at page 85 of the same volume, and has reference to much that is contained in the present Paper.

seventeenth century; but I am assured very positively by two Arabic scholars that they have seen such tiles inscribed so late as a hundred years ago.

WILLIAM SIMPSON, F.R.G.S., *Hon. Associate.*—I have never been in Persia, but I have some interest, in reference to architecture, in the Jellalabad Valley. I do not think that any decided opinions can be given on the leading subject of the Paper, that of Greek influence in Asia. The art-sculptures I found in Afghanistan were certainly Byzantine-like, but I detected in them native art also. The actual knowledge of the subject is at present so slight that it is almost impossible to give a decided opinion upon it.

R. PHENÉ SPIERS, *Fellow.*—I have heard with some surprise that to Persia we owe not only decoration, but construction. My general impression is that, throughout the countries where Saracenic architecture prevails, a great deal of influence has been due to Persia in the decorative details. Such influence may have been produced by the introduction of illuminated manuscripts, or tapestry, or from carpets and other decorative work; but there seems to me to be an entire absence of evidence to show that constructive works are in any way due to Persia. Professor Lewis hints that we owe the great dome of St. Sophia, Constantinople, with its pendentive, to Persia, and he refers to bas-reliefs on Persian monuments, but those representations do not suggest a dome of any size; they seem to be rather the coverings of small square towers. In the pendentive of St. Sophia, one of the curved sides measures something like 70 feet, and it would require more proof of such an immense feature having originated from Persia than has yet been furnished. Our historical knowledge is almost entirely due to Mr. Fergusson, and therefore one speaks with temerity before him, and he has proved, I think, in his books, most conclusively, that the original pendentive at Constantinople came from the Pantheon at Rome, and can be traced through other works, there and at Ravenna. The origin of the sculptured details at St. Sophia can also be traced, since the publication of the work of M. de Vogüé on Central Syria. Many features in the buildings shown in that work are akin to those to be found in the Mosque of St. Sophia, and if dates be compared, there is no doubt we shall find worked out some of the problems of which we see the further development at St. Sophia. The Saracenic architects seem always to have taken the greatest delight in playing with their constructive features. We may assume, to a certain extent, this practice to have been carried out with the stalactite vaulting. In the earliest examples in Cairo of vaulting of this kind, you will find that the upper portions of the vault are not subdivided. In the later examples they lost the idea of the first theory which had obtained, and multiplied the small stalactite vaults so, that it became at last impossible to make out what was the original plan. In the earlier examples there was a definite plan. Subsequently the operations were divided up, and at last you get what appears to be a complicated series of small vaultings, impossible to be drawn, which, however, are really based upon well-defined principles. With reference to the windows, there is no doubt, whatever there may be in India, that in Cairo and Damascus they do contain coloured glass. Professor Lewis has pointed out that the main object is to keep out the intense light of the sun; but not only do they keep it out by preventing the light coming directly through the windows, but these windows are placed very high in the room—generally in the central lantern—so high, indeed, that it is sometimes impossible to see the glass, in consequence of the depth of the plaster divisions. You will notice in one of the specimens that the plaster slopes downwards

You sometimes do not see the actual light through the glass, but only the reflection on the surface of the white plaster.

GEORGE AITCHISON, B.A., *Fellow.*—The subject of Persian architecture, from the earliest times to the present day, is much too vast to be treated of in a single lecture; it might well afford matter for a session. I will therefore confine myself to one series of subjects which I think is fraught with the greatest interest, namely, the stalactite vaulting and the windows. Mr. Clarke was enabled to procure from the architects' guild a great number of their pattern-books, some of which are exhibited here, and it is most probable that something of the sort existed in the Middle Ages, when stellar and other complex vaulting was in vogue. These Persian pattern-books contain the plans only of all the most favourite Persian vaulting. When the size of the space to be vaulted is given, any master-mason can execute the stalactite work from the plan alone. This fact Mr. Clarke proved in the following way: he made a plan, elevation and section of a cornice at Teheran, and wishing to have a similar one at the British Embassy he was building, some hundred miles away, he showed the plan to the master-mason and asked him if he could execute it from the plan alone. The answer was "Certainly," and when it was done Mr. Clarke verified it from his drawings, and found it exact. When we first look at one of these stalactite domes, especially when the dome is on a large scale, its complexity is such that we ask ourselves whether it is not the work of some supernatural being; and it is not until we have measured one, and seen how very simple is the plan, in spite of all its complexity, that we at last admit that it is man's work. We are naturally led to ask what was the origin of this stalactite work. Owen Jones says it was originally suggested by rows of egg-and-tongue mouldings, superposed in some of the buildings of the Roman decadence; but looking at the work in Spain and Sicily, it seems as if some accidental form he saw had inspired some great architect. Let us imagine that some pieces of wood of irregular lengths were put together for making some large patterned Tonbridge ware, and that these irregular ends had been already shaped, then something like a group of stalactites would be formed. Be this as it may, in Spain at least, every wood capital, corbel or bracket of stalactite work, that I had the opportunity of examining, was made up of separate pieces of wood, triangular and square in section, nailed or otherwise fastened together, like the stalactite dome of the Persians. Owen Jones informs us that the Alhambra vaulting at the Crystal Palace was executed like this, using only pieces of plaster instead of pieces of wood. But Mr. Clarke saw the actual method adopted in Persia for plaster stalactite work, which was as follows: The floor of the room to be vaulted was levelled on a bed of ashes, a thin coat of plaster was run over this, and the whole plan laid out; the lines were then cut out with a knife in a V form, and the plaster was saturated with hot suet. A cast of this was taken in plaster about half an inch thick, and the first plan, that is to say, the heads of the first line of stalactites were cut out by the workmen, stuck up horizontally against the wall, and supported by means of sticks and soft plaster; the visible part of the stalactite was then finished by hand down to the wall. Another sheet was then run and the second line was cut out, stuck on as before, and thus continued until the whole was completed. As the faces of the Persian stalactites all form plain rectilinear figures, it is not difficult to work them by hand. That they are so, the pavilion of the Shah in the grounds of the Paris Exhibition of 1878 prove, for these stalactites were all covered with looking-glass. But it seems impossible that the faces of the Moorish stalactites at the Alhambra

could have thus been worked by hand; in fact, one sees in the broken ones that their face was of white plaster, backed with dark-coloured coarse stuff. As regards the windows, I have never been in Persia, but I have seen those at Cairo, and had many executed for me in London. In the houses of Cairo the lower windows are of white clear glass, each pane being circular like a vial, and with a blob in the middle, while high up in the wall are the coloured glass windows, and if it be possible they are more enchanting and fairy-like than the stained glass of the Duomo of Florence or of Chartres cathedral. Instead of the coloured glass being fixed in lead, these Oriental windows have the framework made of plaster from one to two inches thick secured by a wooden frame all round, and with thin coloured glass stuck on the back by white of egg. The design usually consists of pots and flowers cut clean through the plaster, each rib dividing the open portion of the pattern in the full thickness of the plaster, and chamfered each way; the filling-in is usually about $\frac{3}{4}$ in. in thickness and is pierced with large or small holes, and the horizontal parts are chamfered to the angle of the eye of a person sitting on the opposite divan. The effect is got by the reflection of the coloured glass on the chamfers with a very small portion of the glass itself visible, so that the whole sparkles like jewels.

Mr. J. W. WILD (Curator of the Soane Museum).—I caused to be executed when I was living at Cairo a window similar to those described. An old man came to my house and brought with him a frame, something like a frame to hold a slate for pencils. The frame was laid on the ground, filled with plaster, and then left for the plaster to dry. Next day a diagram was made upon it, and the plaster was cut like cheese. The whole thing was soon finished, and on the afternoon of the same day the workman inserted the glass by sticking it in at the back.

THE PRESIDENT.—I am happy indeed to gather from Mr. Crace that the Committee of the Palestine Exploration Fund have determined upon exploring some of those singularly interesting cities upon the eastern side of the Jordan. I can speak with a little personal knowledge, having visited the locality; though I have only had a casual opportunity of investigating the many ancient remains existing there. It will be an important and interesting contribution to archæological science if the Palestine Exploration Fund Committee are able to have them examined.

VI. HISTORICAL DOCUMENTS. By John James Stevenson, *Fellow.*

[Read on Monday, 28th March, 1881, John Whichcord, F.S.A., *President,* in the Chair.]

AMONG the discoveries of these times there is one less noticed than steam and electricity: this is a new way of looking on the past. Till quite recently history was supposed to deal only with grand and heroic events. The actors, seen through the mist of the past, seemed larger than ordinary men. The style proper for history was grander than that of common life. People spoke in heroic language which it was the historian's duty to invent for them. If the speeches were proper to the occasion, it did not matter that there was not a particle of evidence for their authenticity. One wonders if Livy's readers believed that the speeches which he put into the mouths of the speakers were ever really spoken. Probably they neither asked themselves the question nor cared for the answer. It was enough that they were well written, and fitted the occasion. How strange to us, now, is the old notion of parliamentary reporting—that Dr. Johnson's idea of what a speech should have been should have passed as the actual parliamentary utterance. It was no doubt better, and the fact that it was not what was actually said seemed to the readers of no importance. Such an artistic presentment of events, according to the writer's notion of them, may have been better than the reality; but it is not history. Give us the simple facts, tell us what really happened, the actual words the people used—make us realize the circumstances as they really occurred. A Roman emperor in a full-bottomed wig seemed no incongruity, but to us it is absurd. To represent the scenes of the New Testament among mediæval architecture and with mediæval costumes, though it offends us less, we know to be untrue, and valueless as an historical record of the times they profess to represent. But the smallest actual fact, however ordinary and common at the time, which happens to have come down to us, is of absolute historical value as an actual portion of the perished life of former times. It enables us to realize it, and the commoner the fact the more valuable it may be for this purpose. The mediæval representations of scripture scenes are of no historical value for scripture history, but they are of absolute value for mediæval history. They are perfect and incontrovertible evidence of mediæval ideas and modes of thought, of mediæval dress and architecture. Whatever has come down to us, from any former period, is of value for the history of that period, even of more value the more common and commonplace it is, for it brings us close to the ordinary lives of the people. The penny loaves from the baker's shop at Pompeii, the pots and pans from the houses, a pair of Etruscan old shoes, an Egyptian wig, the flint knives and arrow-heads of the old Cave men, a child's rattle from an aboriginal lake dwelling, are more eloquent to us than the grandest passages of historians. These things, when we can touch and handle them, help us to realize the perished life, to feel near it. Writings of no value at the time, dealing with unimportant events, which, after they had served their immediate purpose, were mere waste paper, become by their accidental preservation valuable historical documents. Such are the Paston letters—mere ordinary letters from a boy at college to his mother at home—the accounts of house expenditure of an ordinary household, the inventories of household goods when, on the death of their possessor, they passed to the next heir.

But it is a modern notion to attach value to such useless old rubbish. Formerly the newer a thing was, the more it was prized. This was even the case with regard to important documents. It was the custom to re-write old deeds and charters on new skins of vellum, the old ones being then counted worthless. It was the same with the manuscripts of the scriptures. Those we have are mostly quite modern. It is mere accident, and no special care, which has preserved the one or two old copies which exist. A new copy was always thought better than an old one, just as we think a new coat better than an old one, and when they got the new copy, the old one was regarded as of no more value than a church prayer-book with the prayers for the Royal family out of date. Its only value was the parchment or vellum, which, as far as it was good, was used up for new writings.

The same feeling continued till quite recently with regard to some kinds even of works of art, such as gold and silver plate. Only a few years ago, silversmiths put as an advertizement on their bills, "Family plate melted and re-made." What family would melt their old plate now? Yet historically interesting church bells are still sometimes re-melted for the sake of the old metal. I was told that the fellows of a college, at one of the universities, not long ago had their old plate melted down into useful articles of a neat modern pattern, and another college a year or two ago, being somewhat behind its age, sold some of its old plate to a dealer at the price of old silver for melting. The dealer, however was not behind his age, but realized for it the quadrupled or quintupled value of ancient plate. Silversmiths lament, now, the tons of Queen Anne teapots and three-pronged forks they have melted for old silver, for which they could get twenty shillings an ounce. The rage for the art of this period may be to some extent mere fashion and may pass. Fashion may run up the prices at one time of Etruscan vases, at another of blue china, hawthorn pots or Chelsea shepherdesses; but this new reverence and value for old things because they are old, and the older the more valuable, *cannot pass*, now that it has become evident to those who think of these things that the actual relics of any age, of whatever kind, are the only thoroughly reliable historical documents of that age.

Such documents may be of almost any kind, anything that tells of the life and ideas of the time. For this purpose they need have no intrinsic value, they need not have beauty or art, it is enough that they be authentic. We may think them ugly; for any purpose of ours they may be useless, but we have no right to destroy them, not even if, besides being ugly and useless, we can see no historical significance in them. That may be the fault of our ignorance, just as an Arab who had found an ancient Egyptian wig might regard it as merely worthless old hair. We have no right to destroy them, we are merely their custodians. Wider knowledge, some farther light may give them value to those that come after us.

This new mode of looking on the records and relics of the past is shown in the museums for their preservation, which have been established in every country pretending to civilization. These are quite modern institutions, unknown at any former period of the world's history. Formerly, old things have been preserved for many reasons and in various ways, else we should not have them now, but never, till these latter days, have special buildings been erected, and great expense incurred, for the sake of preserving things which are of no practical use, which are often not beautiful, but because they are historical documents which illustrate and enable us to realize the past history of mankind. The one essential of such records which makes

them worthy of a place in our museums is, that they be authentic, that they be not spurious copies or imitations.

Now of such historical documents old buildings are amongst the most valuable. We cannot put them in a glass-case like a museum specimen, but they are as well worth preserving authentic and unaltered, by whatever means we can, as any of the objects in our museums of which we take such care. Better than anything else they enable us to realize the life of former times. An historical event becomes real to us when we enter the room where it actually happened. This is one of the chief pleasures of travelling. Why do crowds go to Abbotsford? not certainly for the beauty of its architecture; but because they come nearer to one whom we all feel to be a personal friend and benefactor. In an old building we seem to become acquainted with those who built it, and those who have lived in it. We see their ways and habits, we can better imagine how they thought and felt. Imperfections and dilapidations from continued human use, when seen in this light, often acquire positive value. I remember in the belfry of a little country church in France that the bell-rope, rubbing against the side where it came down through the vaulting, had worn a groove a foot deep in it. What countless tollings of the bell it told of? Probably that stone is "restored" now. In the door to the dormitory at Westminster Abbey, opened out a few years ago, the steps are worn down at one side, showing that one leaf of the door was usually kept closed—not a very valuable historical fact, it may be said, yet some have felt touched on realizing that here the file of monks passed daily. I confess to a strange feeling of awe and interest when at Rome I saw the wheel-ruts in the paving-stones of the slope to the Capitol, where the Roman triumphs must have passed.

When we have the actual buildings we can people them. It helps the imagination, in realizing the life of perished generations, to know these were the walls and roof they saw, this was the floor they danced and dined on. When lord and servants dined at the same table in the great hall, there may have been mutual confidence between them, but there can have been little culture in either. The little windows which, from the private apartments, overlooked the hall, showed that the lord would be master in his own house. At Fyfield, near Oxford, such a window, which commanded the solar, was lately removed and inserted in the outer porch, which seems quite needless falsification of history.

The successive alterations in succeeding centuries do not perplex us. We can trace them all, they are all authentic. But when the Restorer enters, confounding the whole into his own notion of what the building once was at some one time, destroying the authenticity even of the original work by scraping it and painting it like his own new work, instead of the pleasures of the imagination we have only perplexity and a deep sense of the folly that would not leave the old building alone to tell its own tale.

The history, through succeeding centuries, of the religious thought and the social life of the people was once written in our churches. Each age had added its record, but not so as to obliterate the older writing. We can read the religious history of the country in its churches—in the great choirs of the monks in the monastic churches, and the small space reserved for the people, the evidence of the gradual assertion of their rights shown in the cathedrals, and of the more rational faith which is still that of the Church of England, but the signs of which, no matter what their richness or beauty, for the last forty years, have been everywhere destroyed as "vile rubbish that got stuffed into churches in the last century or two," as Sir Edmund

Beckett, in his *Book on Building* (page 300), describes this work. I would ask Sir Edmund Beckett, are these not centuries of English history? What right then has he to destroy their records? In an old church we live back again through all the centuries of English history, each generation in its day we feel trod this floor, looked up into this vault; these are the original painted decorations from which the whitewash has lately been uncovered, of which parts remain uninjured. The smallest portion of such authentic original work is invaluable. We thank the generation who, when it became shabby-looking, instead of destroying it, saved it for us under the coats of whitewash. What destructive stupidity it seems to obliterate these records by making new copies over them, not in the same lines, as at Bruges, not in the same colours, as at Salisbury, or by the new blazing crudities of the Hospital of St. Cross.

The principle on which Restorers have almost universally worked—that they should bring an old building into harmony by removing later additions and excrescences, and replacing these by new work of their own—has made the buildings where they have worked their will insipid and uninteresting; it has destroyed their charm, their individuality and their art. As to this, perhaps, tastes may differ, but there can be no question that this treatment destroys an old building as a continuous historical record. The additions of the successive generations do not confuse us. Each is clearly written in the handwriting of its own time, and we can decipher the older record under the newer. The modern Restorer by his scraping and rebuilding of the old work makes it indistinguishable from his new work, and destroys the whole accumulated record by his power of forging the writing of any age, reducing it all to a modern imitation of some single period. We have no right to do this. These records are not ours. Our duty is to preserve them and hand them on to prosterity. We may not like them, we may think them ugly; but that is a consideration which has no place in regard to an historical document. We must not alter or falsify it, in order to conform to our notions of what it ought to have been.

This principle of the value of old buildings as historical documents seems so obvious, if we care at all for the records and history of the past (and surely every civilized and educated creature does), that I almost feel I should apologize for insisting on it. But among the generality of people connected with building it is scarcely acknowledged and but little practised. If it were, their treatment of old buildings would be different. From their habits and training they look on them as existing only for use or beauty. This new appreciation of the value of historical documents is shown by the large measure of support which has been given to Sir John Lubbock's Bill for the preservation of ancient monuments. A few years ago any member, attempting to press such ideas in the House of Commons, would have been looked on as an enthusiastic bore, and there are still members who regard them as mere nonsense in comparison with the sacred rights of property. The architecture of each period is influenced by the religious, historical and literary notions prevailing at the time. But not immediately. It lags behind the general culture. It was long before the revival of classic learning in Europe found its expression in pure classic architecture; or the romantic revival of the last generation was embodied in the accurate and intelligent reproduction of mediæval buildings. And similarly architectural practice is to a great extent unconscious still of the value of old buildings as historical documents, a value long felt by many men of culture, but which has only lately found vocal expression in the Society for the Protection of Ancient Buildings, founded by

Mr. William Morris. I cannot give a better instance of this unconsciousness of the value of old buildings as historical documents than a sentence from Sir Edmund Beckett's *Book on Building.* "Rich people," he says, "who know little of these things from their own experience may take my word for it, as a builder of no small experience, both on a large and small scale, that the restoration of a great old church . . . . . will pay them infinitely better interest for their money, in every way that they can wish to have it, than anything new that they can build. (Of course I am only speaking of ornamental outlay in building). . . . . . Just now there is St. Alban's Abbey . . . . . It wants at least £30,000 to restore it safely and thoroughly. Set the best architect you think you know to build you the finest church he can for £30,000. Do you imagine you would get anything comparable to St. Alban's?" There is no hint here of an old building being of historical value; and in his second edition Sir Edmund Beckett notices the idea only to abuse it. He looks on St. Alban's as so much work done to his hand as a basis for carrying out his own ideas of architecture; and in the restoration which is going on, he is carrying out these ideas. The *Building News* of 26th November 1880, gives an elevation of the new west front with the title: "Sir Edmund Beckett, Bart., architect of this." The description, which accompanies it, states that, as no traces remain of the original early English front, the restoration must be an invention of everything except the very late perpendicular window—and that this is in such a state of decay that "any restoration of it would be only rebuilding a modern copy of what has been pronounced by as high an authority as any in the world, 'a very bad specimen of a very bad style.'" I may observe that the ruinous state of this window is denied by others. The notice goes on, "Sir Edmund Beckett, who has become legal master of the position, through the cessation of the subscriptions, and the committee being left, not only without funds, but in considerable debt, has determined not to rebuild it, nor to attempt an imaginary restoration of the unknown Early-English design, but to adopt the Early-Decorated or Geometrical style."

In all this there is the frankest ignoring of St. Alban's Abbey being an historical monument. It is merely a subject for Sir Edmund Beckett to try his hand at architecture on; and it is the same with other parts of the church. "Sir E. Beckett," says the same notice from which I have quoted, "has already inserted windows in the four dark bays at the west of each aisle, which Sir Gilbert Scott objected to because there were none before, either because they were impossible by reason of some Abbey buildings standing there, or, after they had fallen and let down the walls and vaulting, the walls had been rebuilt roughly with no architectural character." Surely the position of the Abbey buildings is a question of some archæological interest, for the determining of which Sir Edmund Beckett's new windows destroy the historical evidence. "Now that the windows are in," says the notice, "they are universally considered a great improvement." Not universally; there are some, whose knowledge and taste give authority to their opinions, who thought that those dark bays gave special character and interest to the church, and who do not sympathize with the common-place notion, however universal it may be, that peculiar features should be destroyed, and al our churches reduced to a dead level of uniformity.

In a letter to the *Times*, in the controversy about the west front, Sir Edmund Beckett says that his design has been admired by every one who has seen it, except one or two influenced by jealousy, and that the exhibition of Mr. John Scott's rival design brought over all opponents.

To those who think our first duty to old buildings is to preserve and not to destroy them, it is a matter of indifference which design is best. Compared in value with the ancient work which is destroyed, both are worthless, Mr. Scott's so far better that it preserved the old window; and, as to their value as architecture, I venture to assert, and I know many whose opinions are of value agree with me, that the old front is better than either in its simple dignity and venerableness, as compared with their fussiness and striving for effect. The west front was stable if it had been let alone.

Sir Edmund Beckett's views are at least logical, and they have old authority on their side. Like the mediæval architects, he does not hesitate to destroy old work, as in this case, because, like them, he believes he can replace it with better designs of his own. But he is almost singular in these views. This opinion of the merit of their own designs as compared with older ones is not generally held by modern artists or thinkers. Restorers profess to try to keep the old designs, even if for some reasons they are compelled to substitute new work of their own. It is those who are most original in producing new work who have the greatest veneration for the old. Many instances of this might be given did time permit. If there be truth in the views I have been stating, or even in the common views of restoration, one who holds Sir Edmund Beckett's opinions is not a proper custodian of our ancient buildings. Paying money to alter them ought not to give a claim to the custody of national monuments. They contain the history of the nation. They are the national property. But the ample terms of the faculty he has obtained seem to justify Sir Edmund Beckett in talking of St. Alban's as he does, as if it were his own property; and it seems a recognized principle with the Chancellors' Courts that if anyone will pay the money he may do what he likes with our historical buildings. This principle was followed in the restoration of St. Patrick's Cathedral, Dublin. As Sir Benjamin Guiness expended a large sum on it, he was, like Sir Edmund Beckett, allowed to be his own architect. He has destroyed the beauty of the church. Mean new stalls replace the old carved oak ones of the Knights of St. Patrick, which it is questionable if the money he expended justified him in removing. The restoration of the other Cathedral which Dublin possesses was undertaken by Mr. Roe, a wealthy distiller, who more modestly and wisely intrusted the work to Mr. Street. A noble church is the result, practically a new one, and comparing the two cases I must admit that Irish whiskey has done more for ecclesiastical art than Dublin stout.

The treatment of the Cathedrals of St. Patrick and St. Alban by the two wealthy baronets who have amused themselves as their architects is not usual, nor are the principles of restoration which Sir Edmund Beckett proclaims those commonly held by the profession of architects. But those principles have the merit of being logically consistent, and they have the sanction of all the great periods of architecture. Like the old architects, Sir Edmund Beckett considers his own work better than the old, and that in destroying the Perpendicular window, and replacing it by his own, he is doing a service to art. Professional architects are usually more modest. They claim only to remove excrescences and alterations of later times, and either to bring the building back to the condition in which its architects left it, or to complete and carry out their unfinished design. They regard the old as of historical value, and, even if they believed they could do better, do not think themselves entitled to attempt it. But this view is not logically consistent and practical like Sir Edmund

Beckett's. It acknowledges that old buildings are valuable as historical records, and therefore they reproduce them from their own conjecture and imagination. This is absurd. A manufactured historical document of a later age than the time it professes to belong to is worse than useless, it is misleading. It falsifies history. The only thing to do with an historical document is to leave it alone, taking all care to preserve it. If, like most old buildings, it be a document not of one age, but containing the work of successive periods, we must preserve them all. It may be imperfect, but we lessen its value and destroy it as a document by attempting to complete it from our own conjectures. It would be absurd to finish the carved mouldings of the Erechtheium which the Greeks left uncarved. An old building may have later additions, but to remove these is to destroy records of the time to which they belong, while to substitute new work for them, especially if it is so well done as to be indistinguishable from the old work remaining, makes old and new alike valueless as a record. Yet this has been a common practice. It is due to the same habit of mind which in literature made historians supply proper speeches for their heroes, and imaginary reports of the House of Commons debates, like Dr. Johnson's. The absurdity of the practice in literature is now apparent; Carlyle by his reverence for absolute authenticity finally finished it. But architecture, as we have seen, lags behind in modern thought, and the confusion of ideas which it springs from still prevails in restorations. Because a building is of, say, the thirteenth century and therefore interesting, Restorers turn it into a new building. They talk of their work as thirteenth-century work, perfectly unconscious that it is and can only be nineteenth-century work. At best it is only a copy, and no one seeing it can tell whether it is an accurate copy, or the product of the Restorer's imagination, and thus its value as an historical record is destroyed. Till lately such deception was impossible, old work was not sufficiently understood to make accurate reproductions of it. Now a restoration is like a forgery of an old writing in which the character of the old letters is imitated so accurately as to prevent detection. If a building is an historical record, treat it as such, and do not alter it or falsify it. I do not forget that buildings are something more than historical records, they have value besides, for their beauty as works of art and for their practical uses, which in dealing with them an architect must take into account. As to their beauty, it is a question whether it is not better preserved by leaving them alone than by restoration as commonly carried out. I certainly think so, and I know many painters agree with me. As to their use, it is right to keep an old building in use: it is the surest way of preserving it. It is to their being turned to some use, seldom that for which they were built, that we owe the preservation of almost every ancient building we possess. If not used they fall into ruin from neglect, or disappear as stone quarries. Not the Goths or Vandals destroyed the great buildings of Rome, but the Romans themselves, when from the decay of the city they had ceased to be used. The Emperor Majorian, in the fifth century, "*a great and heroic character such as sometimes arise in a degenerate age to vindicate the honour of the human species*,"* attempted to stop the destruction by a fine of two thousand pounds sterling on every magistrate allowing it, and by the amputation of both hands and a whipping on their officers.

The Parthenon, the Pantheon, and most of the Egyptian temples which remain, were

* See Gibbon's *Decline and Fall of the Roman Empire*, chap. xxxvi.: Character of Majorian, his salutary laws, the edifices of Rome, &c.

preserved as Christian churches; the amphitheatres of Rome, Nîmes, Arles and the theatre at Orange, as mediæval fortresses. We have emerged from barbarism and acknowledge the value of old buildings independently of their use, and would not now destroy the Parthenon or the Colosseum, though practically useless, yet an old building is more safe if we can find a use for it. But unless we act like barbarians we must not forget that it is an historical record, and we must leave it unused if its use involves alterations which injure its historical value. It is worth the cost. I can conceive no better employment of our wealth. Yet it is wealth which is the great destroyer. The City Companies have latterly been employing their money in pulling down their old halls and building new ones, in destroying the few old buildings which remain in London to increase their income from their sites.

The treatment of old houses is difficult. Changes may be necessary if a family is to live in them, but it would be better to keep them as ruins than make such changes as destroy their value as a record of the life of the old time. But that is not necessary, some use could be found for them, which, while giving a motive for keeping them in repair, would leave their historical value intact. The fashion, which lately prevailed of making ruined houses and castles habitable, has in most cases been more destructive to their value as documents than keeping them as they were. It involves their total destruction by renewal of their internal arrangements, the evidence of old manners and life, by substituting for them modern conveniences. And when this is done they are more costly and inconvenient than new ones. Many who possess old houses are willing to put up with some inconvenience rather than injure their historical value by altering them to suit modern uses.

In churches a more serious question than mere convenience arises, for it is urged that all considerations must give way to the proper conduct of Divine worship. This plea is unanswerable. The new practices, introduced in this generation into the worship of the Church, must involve some changes in the fittings. But it is made an excuse for changes by no means involved in it. One cannot ask a congregation, who have ceased to feel the old custom of responses by the clerk a fitting mode of conducting service, to retain a three-decker pulpit which conceals the altar. But this and similar changes is no reason why the walls should be stripped of their plaster; the old monuments torn down from them and collected in a batch out of sight; the floor, which was often a curious page of history, taken up and replaced by Minton's tiles; the rich classic oak panelling of the chancel removed, and even Perpendicular windows and roofs destroyed, because we dislike the style. Oak panelling and Renaissance tombstones on the walls are not incompatible with the new arrangements for the service, and we would honour God more, I think, by respecting the work of each generation, who did their best to honour the church, than by thrusting it out for our own.

I shall not venture an opinion as to whether galleries and high pews are incompatible with Christian worship. High pews are out of fashion, but in the opinion of some—both good architects and high ritualists—they have a better architectural effect than the benches usually substituted for them. In Wren's churches they are part of the architecture. Wren objected to pews, but when he used them he made them an essential part of the architecture of the church, and their destruction, which is going on in the City churches, is destruction of his design. They could be made into low pews by raising the floor more easily than by cutting off the top or substituting new Gothic ones. Galleries are not found to be inconsistent with

the service in those churches which depend for their income on pew-rents, and they are features of the great Byzantine and mediæval churches. It is rather mistaken architectural notions which have caused their removal in our churches, with the result that the whole design of the church has to be altered, often spoilt, by a great addition to make up for the lost room. These galleries were often picturesque. They did not destroy, but merely overlaid the original design, which with a slight effort of imagination could be realized. I sometimes think that the desire for restoring, springs from a lack of imagination, from inability to realize the old effect till it is actually completed and made out before our eyes. Hence the desire to have every bit of foliage, every break in a moulding, completed and made perfect, just as many see no beauty in the Elgin marbles, because the legs and noses are broken. They would like them restored, and, being architectural sculptures, probably would have been restored had the Parthenon been in England. At an earlier period even sculptors would have restored them, but their culture now prevents them. May architects attain to the same pitch of culture before all the ancient buildings of the world are restored!

The plea of convenience goes a very little way to justify the usual mode of restoring churches, and there is still less ground for alterations in order to beautify them, even if we had the absolute confidence in our own taste possessed by Sir Edmund Beckett. He has no difficulty. He would "extirpate without mercy" anything he thinks ugly, thereby constituting himself the standard of taste not only for the present, but for all time. This is not in accordance with the teachings of history, which shows that taste changes. The merits even of the despised "Perpendicular" are coming again to be appreciated, and its destruction everywhere by restoring architects regretted. There are already signs of this in the practice of some of our best architects. But even if we could be as cocksure as Sir Edmund Beckett, this gives us no right to alter and falsify historical documents, even if we think it improves them.

I am not blind to the difficulty of preserving buildings as historical documents. They become useless and unsuited to modern requirements, and cumber valuable ground, or, worse still, they decay; the floors get rotten, the rooms foul and fever-haunted, and they fall under the ban of the Dangerous Structures Act. Notwithstanding all these things, if we thought them of sufficient value, old buildings could be preserved. These things do not prevent our preserving older work which we think valuable. The important thing is to keep old buildings in repair—a prop is better than rebuilding—and, if they are so far gone that some renewal is needed, to remember that the old stones and timbers we can leave are, even if not perfect, better than new ones. Their preservation depends on our valuing them enough to stand the cost and inconvenience of keeping them. Their chief enemy is the love of newness, the desire of change, which is pleased even when the change is for the worse, like the Shah of Persia, who on returning home from his European tour had the books in the royal library rebound in modern European style, destroying beautiful old Persian bindings. How many of our restorations exhibit similar barbarism! To such minds it seems absurd to prefer the old to the new. The new to them is smart, bright, showy, complete; they cannot feel tenderness of age or see the value of the records of history.

If old buildings are national historical documents, it is a fair question for argument whether any single architect, however able, should have the sole power of altering them. It

is not unreasonable that the autocratic authority, which an architect claims in his own original works, should have some limitation in dealing with works which are not his. If doctors do not think it inconsistent with their dignity to consult with their fellows in the case of a patient, neither need architects as to how best to preserve a national treasure for future generations. There are few restorations as to which different views might not be taken as to what should be done. I have found curious proof of this. A society of architects, counting several well-known members of the profession in its ranks, makes an annual excursion to some ancient buildings. On the questions which occasionally arise as to their restoration the views are sometimes as various as the members. All agree as to preserving them and keeping them in repair, but in the doubt as to the alterations necessary the concensus of opinion tends towards leaving them alone.

In many cases I have noticed that architects, who have no scruples as to their own restorations, would minimize the extent of a restoration carried out by others, and this from no unworthy motive, but each man has his own idea as to what he would do; the old work is more interesting to him than the new work substituted for it, for it gives room for his imagination. This may account for the strong feeling in this country against rebuilding the front of St. Mark's at Venice. Though rejoicing in it, I cannot quite understand it, while many restorations as destructive are going on here. It is said that an Italian committee has been formed for the preservation of St. Alban's! I wish it were true. I am sure I would gladly abandon Sir Edmund Beckett to them if they could make anything of him. Unfortunately such discussions occur often after the restoration is done, and are as useful practically as a consultation of doctors after the patient is dead. It would not be unreasonable to have such consultations as to national monuments before they were altered; among other benefits it would relieve architects of having to do things of which they disapproved. Sir Gilbert Scott lamented that he had occasionally to act against his opinions, lest if he threw up the work it should fall into less scrupulous hands. The Society for the Protection of Ancient Buildings has had some experience of such discussions, the architects of restorations in most cases courteously admitting that these are questions of public interest as to which the public are entitled to express their views, but at the same time treating the building as they choose. In some few cases representations are treated with silent contempt or with resentment, more frequently, however, by the clergyman than by the architect. I have sometimes wondered whether the influences of this Institute could be exercised in bringing about a discussion of restorations before they took place. Professional habits are against it, but it might be justifiable on the grounds that our ancient monuments are the property of the public and of posterity. The standing of the Institute would give weight and authority to its opinions, and I am confident that the more the question is discussed, the more will opinion lean to preserving our old buildings as they are.

In a discussion on this subject some years ago, one speaker asked whether the restorations of the last forty years had not preserved more old work, which without them would have perished, than they had destroyed by renewal and alteration. I believe that utter neglect would have been less destructive than these restorations. What remained would at least have been authentic, not destroyed, as historical documents, by new work which we cannot tell from the old. But though neglect be less destructive than restoration, no one proposes it as the

proper treatment for old buildings. Keep them in repair, keep them water-tight. Prop up the walls, rather do this than rebuild them. Do not mind their being out of perpendicular, if they are not insecure. Above all, let no architect take more restorations in hand than he can personally superintend and be responsible for. I have heard of one who had actually a lithographed specification for his restorations, ordering the same destruction in every case of the ancient plaster on the walls, the same removal of the old monuments, the same tearing up of the old pavements and substitution of modern tiles, the same new scraggy brass altar-rails. Why this hurry to get every church restored at once? Better wait and have it rightly done. It can easily be kept from tumbling down meanwhile. Why should this generation take upon itself the right of altering, as it likes, the records of every previous generation in English history? or still less destroy them, as records, by rendering them indistinguishable from its own work?

One thing I am sure of, that unless the present continued destruction and alteration of old buildings ceases, our descendants will have hardly one left to look at. The whole records of the past will have become merely nineteenth-century records. Each alteration as it occurs may seem of little moment; but the process is universal, penetrating by the influence of the clergy into the remotest localities. It is rampant in France and Italy and the rest of Europe, and soon hardly a building will be left a continuous and authentic record of the past. One City church a year pulled down, or its interior architecture destroyed by pulling out its old fittings, may seem of little matter, but this rate will insure the destruction of all of them in a short lifetime. It is false to plead spiritual benefit as a reason. The Ecclesiastical Commissioners spend the proceeds of their destruction, and more, in restoring chancels and churches, which, in my opinion, is too often only another mode of destroying them as historical documents.

In each case the architect may think he is giving a new building, handsomer and better than the old. I do not admit this. Restored churches have, almost without exception, a dull sameness which destroys their interest and makes us turn from them with disgust. Their colour and picturesqueness, due to their imperfections, to the wearing of the stones by time, to the moss and lichens, are gone. What painter would think of making a picture of a restored church? But even if restoration improve the building, it is a loss to the country, for in almost every case it involves its destruction as an historical document. I am, however, willing to believe that the common practice of restoration, which has played such havoc with old buildings, does not proceed from love of gain. It is due to a mistaken method, old habits, and an unconsciousness of the ideas which are becoming more and more prevalent on it. Opinion, as indicated in many ways, is going against the present practice of restoration, and more and more appreciating the value of old buildings as historical records; and I do not despair that even architects and the clergy may come round to this view before all the old buildings of Europe are destroyed, as historical documents, by restoration.

Sir EDMUND BECKETT, Bart., Q.C., *Hon. Associate.*—Mr. Stevenson's Paper seems to me a very feeble repetition of the kind of opinions and statements—it would be absurd to call them arguments—which were refuted and exposed by Sir Gilbert Scott,* Mr. Street and

* See note at foot of page 192.

others, in 1877, in a manner which would have satisfied most men for more than four years. He has certainly been more discreet this time, so far as I can judge from the extracts,* in omitting all reflections on any specific restorations except one, in which he could make sure of more sympathy at the Institute than he got last time. Another proof of his possessing that better part of valour is his silence about the contests in which his anti-restoration Society have been engaged since 1877, at Southwell and Carlisle, and I may even add St. Alban's, with their usual success. But vague generalities and platitudes on such a subject can do no good. It might be of some use to warn mankind against employing dangerous Restorers who have committed certain specified atrocities; but I cannot imagine what good Mr. Stevenson flatters himself he is going to do by warning mankind against the only person whom he specifically attacks now, inasmuch as he is certain not to be employed by anybody in that way, and he has already learnt how gratuitous advice is received by the Courts which have to determine such matters if they are disputed. However, it is difficult to fathom the depths of some men's confidence in their own powers. Mr. Stevenson perhaps imagines himself to be the coming man of the anti-restorationists, whom the world has been waiting for to change the destiny of the west front of St. Alban's, and either to convert or frighten me into letting it fall down, as it very soon will if let alone, or else into rebuilding it according to the dictation of somebody else. He may persuade himself, too, that the time is at hand when the decision of these things is to be taken out of the hands of the proper legal and ecclesiastical authorities, together with those who pay for the work, and hand it over to those who have nothing to do with it, which must be accompanied with a power of taxing somebody to provide the funds; and that it is our duty to convince a set of meddling strangers, and not their's to convince us who have the work to do, which they certainly will not by making statements about facts which we know to be wrong, and expressing opinions which we have no reason to consider worth a farthing, but very much the contrary, seeing the absurdities with which they are accompanied. For when the same people advocate letting buildings fall down, retaining deal pews and plaster screens, and anything else, we know what their opinion about the anything else is worth, even if it does not admit of absolute refutation. Though I am not going to argue with people of that kind, who neither understand nor want to understand what they talk about, it is sometimes expedient to expose their misrepresentations about matters in which more rational persons may be interested. I shall appear ungrateful for the compliments Mr. Stevenson pays me in saying that my "views are at least logical, and they have old authority on their side," and that I am "like the mediæval architects;" but I cannot help it, any more than I can return them or pronounce his views either logical or mediæval, or anything but irrational and absurd. Moreover, it appears that, however logical and supported by authority my views may be, my practice is heretical and dreadful. He says that I do not hesitate to destroy old work, because I believe I can replace it with better designs of my own. There is a sense in which this is true, and another in which it is false, as is usual in many ingenious libels and mis-statements. The public are intended to take it in one sense, and the author will defend it in the other as soon as he is taken by the throat

* This communication from Sir Edmund Beckett was sent in the form of a letter to the Secretaries, who, previous to the reading of Mr. Stevenson's Paper, had provided Sir Edmund with the extracts which were published in the PROCEEDINGS on the 31st March last.

and made to say what he means. If "old work" means comparatively modern brick walls, with the old ornamental stones tumbled in as rubble, parapets of the churchwarden style, lime-washed daubs of sham panels on rotten thin boards of the last century, roof-timbers which your oldest Member condemned as unfit to stay 50 years ago, and which would probably have all fallen together, with their attached irons, in the snow of the last two winters, and perhaps brought down the whole clerestory and more with them, then undoubtedly he is right, and may make the most he can of it. But if he really knows anything of what he writes about (which I doubt from certain internal indications), he knows that not a single bit of genuine Gothic work, or work of any architectural pretension at all of any date, either in wood or stone, has been destroyed at St. Alban's since I have had anything to do with it, if it was capable of standing safely any longer. Of course, ignorant people can pronounce anything capable of standing because they see it stand yet; and then others, who are not quite so ignorant, but something worse, avail themselves of such statements by saying that "the ruinous state of (whatever it may be) is denied by others," and so avoid pledging any reputation of their own, or of anybody else, to the denial, and yet take the benefit of it—a mode of controversy which is thoroughly contemptible, but too common in other matters as in this. The fact is that the west front of St. Alban's ceased to exist as architecture, except the central part, and became brick walls long ago; and now the central part is also simply dead of old age, bad construction, worse building, and stone entirely unfit for external use, and has only two alternatives—to fall down or be rebuilt before it falls. Fortunately, enough remains of the inside of the porches to enable them to be, in the common sense of the word, restored, that is to say, retaining some of the old stones, together with some new ones copying the old; many of the external arch stones of the central porch have also been found used as rubble in the modern walls. That being so, the only question is the mode of rebuilding the west front, except the porches; and that has nothing to do with the subject of "Historical Documents," as Mr. Stevenson absurdly calls it, as if any good were to be done by using common words in a sense in which no man understands them. It can never be an historical monument (to speak English and not nonsense) again. Even if anyone proposed to copy it, there is absolutely no architecture to copy, except that vile Perpendicular window, about the ugliest in England. Bad as it is, I contemplated letting it alone if it would have stood being let alone. But it would not, and I will certainly not spend sixpence in rebuilding or copying such a thing, which is the real meaning of "restoring" it in its present condition; nor would I let anybody else, if there were anyone so foolish as to offer it, spoil the whole design by sticking in such a window as that: which never had any business there at all, and belongs to the period when the depravity of the monks of St. Alban's had become the scandal of all England. Nearly all the original windows in the church, except some of the clerestory lancets, are decorated; and therefore so are the seven new ones, which I have inserted already in the formerly dark bays of the isles, which everybody can see are an immense improvement to the church. I am quite disappointed to see nothing in the extracts, but you will doubtless have the defect supplied, of the criticism of which Mr. Stevenson gave me notice in a letter inviting me to come and make sport for the Philistines this evening, "on the inferiority of the new west window to the present one both in design and proportions." Design, being a matter of taste, will be very easy for him to dispose of, and I am very glad to find that such a critic as

Mr. Stevenson does disapprove of it. I should be more alarmed than I have been at anything I have heard of it, if he did not. And I am too much used to such criticism of designs, which end in being generally admired and sometimes even copied, when they are done, to pay much attention to it, especially after the many opinions I have already received in favour of this design, and some letters begging that I will not alter it—which perhaps some persons may think superfluous. But when he talks of the inferiority of the new proportions to the old ones, he is evidently drawing a bow at a venture, and taking for granted that, with my usual audacity, I have altered them for nothing but my own fancy. And yet he could very easily have ascertained, as the drawings are published, that the outlines of the new and old windows are identical, as well as the number of the lights, except what is due to the arched sill, which is necessary for any sound construction there, as the present window actually stands on the thin vaulting of the porch; or else we must have had a window of really different and worse proportions. So the moment he gets out of the safe regions of opinions, which admit of neither proof nor refutation, into the dangerous realms of facts and measurements, not a word that he utters is correct, at least about the restoration of St. Alban's, which alone I am concerned to notice. It is really what they call breaking flies upon the wheel, instead of blowing them away, to criticize the platitudes and paradoxes of which the extracts at any rate are composed, apart from these special blunders about St. Alban's, which were obviously meant to be the plums of this very heavy pudding. Still a specimen or two are irresistible, for here is the very latest nostrum of the anti-restorationists for keeping up old buildings:—"It is right to keep an old building in use: it is the surest way of preserving it. . . . If not used they fall into ruin." That then is the true way to restore churches that are on the point of falling; go on boldly using them. Never mind if people tell you they are dangerous; probably they know nothing about it, at any rate "some people deny it." If a congregation is buried in the ruins, what can be a more glorious and beautiful end? If cracks are heard and seen, and stones begin to fall occasionally by way of warning, why then perhaps you must give it up and wait serenely for its fall, as they did at Chichester when they found the tower hopeless. The ruin will still be very interesting to artists, who, Mr. Stevenson assures us, specially agree with him, and I daresay they do. But though use is the thing to keep buildings in repair, we must have no restoration for such a base object as use:—"unless we act like barbarians . . . we must leave it unused, if its use involves alterations which injure its historical value," as of course every restoration and every new stone put in for repair *pro tanto* does. To people of this order of mind and understanding, Southwell is as Stonehenge, and St. Alban's as Avebury, or a Cæsar's Camp.

WILLIAM WHITE, F.S.A., *Fellow.*—This subject, as some of you know, is one in which I have been deeply interested for many years, and upon which I have had several small controversies, and one indeed with the anti-restoration society. Not that I have objected to the principles which they have propounded, or to the principles which Mr. Stevenson himself has propounded this evening, for if you will allow me I will read four or five lines which fully expressed my opinion some years ago, and which I have seen no reason whatever to alter since. It is, "If I should seem to be an opponent of the advocates of conservation, it is not that I object to the general principle or practice of conservation, but only to the exaggerated ideas of what is possible and what is prudent in the proposed retention of old work. They

deal as I think lightly, rather than wisely, with the real practical difficulties attending it and surrounding it, and perhaps it is not surprizing if zeal, rather than deference or discretion, should guide their counsel." Now some remarks made by Sir Edmund Beckett I think will apply very closely to what I have just now intimated, with reference to the argument which Mr. Stevenson has used; we are told by the latter that it is better to leave a building useless, than touch anything which would alter its historical character. Well now, if that is done, I say that Mr. Stevenson has expressed himself in a perfectly illogical manner, and in a most impractical manner, in a way that will not meet the views which he has himself propounded, because, if you leave a building unused it will very soon be swept away. According even to his own showing, it is use which has preserved for succeeding generations the great mass of our English churches, but in saying this I do not for a moment suppose or pretend to assert that there has not been a most lamentable want of conservation in their restoration. I must, indeed, confess to some of my earlier works, in which I was not so scrupulous as I ought to have been in the restoration of the old work; but I say that subsequently I have suffered for that, for I have had the credit of doing that which I have positively refused to do, and the vicar and churchwardens have behind me gone and destroyed the work. There is one other point on which I would venture a word upon what Sir Edmund Beckett has said: that design is a mere matter of taste. Now I say design is not a mere matter of taste. I say it is capable of analysis, of the exercise of reason in almost every particular in which it is worth defending. There is, it is perfectly true, a spirit in a design which it is impossible for anybody to argue upon—that is to say, the expression; and expression depends very much indeed upon that misused and abused quality of sentiment and poetry. I say that one of the reasons why the restoration, the preservation, of our ancient buildings has taken such a hold of English minds, is due to that great sentimental and poetical character, Sir Walter Scott. He imbued the English with the thorough feeling of all the associations crowding around our ancient buildings, and I am sure that in that respect he has been one of the great educators of the English nation.

EWAN CHRISTIAN, *Vice-President.*—I think Mr. Stevenson's Paper was so completely answered on the last occasion when he adduced arguments similar to those he has brought forward now, that I do not see why I should say anything more. Still there are one or two things I must touch upon, and first there is the question of pews. I have as great a reverence for old buildings as Mr. Stevenson has, or any other gentleman who thinks with him, but as I said then I say again, that I believe that dreadful pew system was one of the most murderous things for the Church of England that ever was invented. It has kept the poor man out of the church, and the churches are the proper places in which to see the poor man. The whole of the parishioners should be allowed to go there freely, but how can they if you shut the churches off into square boxes?—however beautiful the panelling may be—as I have seen them with one person in a pew where eight ought to be seated. I am one of those insane persons who long to see the day when there will be free and open churches. When I was in Venice last autumn, I could not help remarking how delightful it was to see every grade of society mixing there on the floor of that magnificent church. The poor peasants might come in and spend an hour or two, and if they only looked at the mosaics they would find a series of lessons in Christian history such as are not to be found anywhere illustrated, so far as I know. I have longed to see that day in England, when the churches shall be entirely clear

and free of all those horrible pews. I would ask Mr. Stevenson, when does History end? History has been making—making up to the present time—and I suppose at some time it is to come to an end, but when? [J. J. STEVENSON, *Fellow.*—It ends when it begins to falsify in copy.] I perfectly understand his view in that respect. According to his view anything that is historical, whether it be the work of the churchwarden or of the village carpenter should not be cleared out of any church, because it has been done at one period of history; and even though it illustrates a very bad period of history, still it is historical, and therefore it should not be cleared away! I do not agree with that. If in any public building there is anything in the way of art—*leave it,* whether the work of art is of one age or of another. Preserve, I say, a real work of art. As to the so-called restoration of St. Patrick's Cathedral, I entirely agree with Mr. Stevenson that it is perfectly awful. It makes one quite miserable to walk through that building and see what destruction has been wrought. Mr. White has very properly alluded to the churchwardens and vicars, and I have had things done which have annoyed me beyond measure, and been credited with doing them when I did all I could to prevent them. I have in my mind a church in Norfolk, where I insisted upon retaining one of the earliest pieces of the communion rails of the time of James I. The churchwardens and the vicar were dead against me, and after I left positive orders to my contractor not to touch this rail, these men went into the church, took the rail out, and burnt it. And this sort of thing has happened in many cases. The vicars and churchwardens are sometimes a little too strong for us, and we cannot help ourselves. Then Mr. Stevenson has said something about chancels. I have had a great deal to do with chancels, and I should like to know whether the history of the chancels ought to be left? A pretty history it would be—a history of the most awful robbery that I believe has ever been committed by persons supposed to be of good reputation: the lead taken off the roofs and tiles substituted, old oak roofs taken off, miserable fir poles put in the place of the old timber, and every conceivable kind of destruction wrought. Am I to leave that piece of history, or am I not quite right in removing it, and putting something better in its place? I think I told a former meeting about a particular chancel in Wiltshire, where one in authority had taken the lead from the roofs and put on slates, cut down all the mouldings and plastered them over. I had the great pleasure of making him restore those things, and the lead he had taken. In that case, the only one, I caught a living man, but I have wished many a time I could summon the dead ones from their graves to answer for similar misdeeds.

LIEUT.-COLONEL LENOX PRENDERGAST, *Hon. Associate.*—I think I have scarcely a right to touch upon a subject which is nevertheless most important, namely, the suggestion made by Mr. Stevenson that this Institute should put itself in the position of advising those who have a great interest in the old buildings it is proposed to restore; but perhaps I may be permitted to say that I believe it to be a most important thing. It seems to me that country gentlemen, and those who take an interest in their own localities, are scarcely able to form such a judgment as is commensurate with the importance of the cases that often arise, and if it became generally known that this Institute was prepared to come forward with alacrity and give its opinion when asked, I cannot but think that many a valuable detail in ancient buildings might be preserved, and certainly many a mistake would be avoided; and speaking generally, satisfaction would ensue to all concerned. It appears to me that the criticism made

to-night about St. Alban's was chiefly directed against amateur restoration. That is only a rare case. More generally members of the profession are employed. The restoration of Gothic buildings at this moment may really be supposed to be pretty well done, but there are existing now some most interesting and scientific buildings (I allude especially to the works of Wren), about which I am afraid we must acknowledge the most lamentable ignorance. To attempt to restore or deal with buildings such as Wren raised, without a thorough knowledge of the grammar of the style, is simply to destroy and to spoil. Therefore Mr. Stevenson had my most complete sympathy when he pointed out that to do away with the original high pews was to destroy the effect intended. I was only last week at the church of St. Stephen, Walbrook, which has lately been "cleaned out." I confess, apart from questions ecclesiastical, that it was to me the greatest satisfaction to find that they had left the pews alone, and I was walking round thinking what would have been the effect of their destruction. The whole of the columns are stilted for the express purpose of receiving the pews. If you had once destroyed that, the whole preposition of your columns would have been gone. Some Court of Appeal should be available in cases of this description, and I cannot conceive a more important duty than for the Institute to place itself in such a position that the public may be invited, and even compelled, to come here for advice.

Professor KERR, *Fellow.*—It would be a pity if Mr. Stevenson should go away and think there was no one who sympathized with him in a much broader view than those seem to have taken of the matter who have discussed his remarks. As for any altercation between him and Sir Edmund Beckett—that we may leave to the parties themselves. It is very clear to me that Mr. Stevenson does not intend to confine his remarks to churches. He has a much more important and interesting purpose, which is this—to impress upon the public mind the desirableness of retaining the relics of antiquity and of periods more or less remote—in fact guarding them for the sake of the interest which attaches to the past. I am not one of those who live in the past, and I am afraid Mr. Stevenson is. But at the same time I think we can all agree with him in that which I have suggested as being his real purpose, not merely in churches, or what are called ancient monuments, or great works as distinguished from small, but in the houses of the land which are altogether historical houses—the houses which have, to those who can read the story, the language of history impressed upon them. I understand Mr. Stevenson's object to be to express a hope that in time English people will learn to treat all their historical records of buildings with a respect which they do not manifest at the present moment; in that view I think all architects of culture must sympathize with it, and I think in course of time the public will sympathize with us if we can but lead the way. As to allowing the question to be submerged in the waters of ecclesiastical or theological controversy—nothing could be more mistaken. Of course we must contend with each other upon ecclesiastical as upon all other questions, for where there is no contention there is no progress. Still it is not merely the ecclesiastical question, and the raising or keeping it within the limits of the restoration of churches, upon which Mr. Stevenson treats, but he dwells upon the broad ground of the universal recognition of the interest attaching to the records of the past.

The PRESIDENT.—The remarks that Professor Kerr has just now made are certainly identical in part, although far better expressed, with those I was about to make to the

meeting, namely, that I appreciate the intention of the Paper of Mr. Stevenson in a far broader light than was apparent to Sir Edmund Beckett or to Mr. Christian. At the same time, although the Paper is very suggestive and provocative of a long discussion, and I think that the discussion might have been lengthened considerably with advantage, yet the hour is now somewhat late, and I have no doubt that Mr. Stevenson will think proper to make some few remarks in reply.

J. J. STEVENSON, *Fellow.*—With regard to Sir Edmund Beckett's letter, it is the old saying, that "hard words break no bones." I should have preferred that he had been present when I instanced S. Alban's Abbey as an example of absolute and reckless destruction of an historical monument. It was not because Sir Edmund Beckett is not an architect that I criticized him especially. Those who know me would believe that that fact would not let me attack him rather than anyone else, but simply because I think it one of the grossest cases of ignorant interference with a valuable work that we have experienced in these times. It might have been some benefit to St. Alban's Abbey if Sir Edmund Beckett had fairly heard and answered my criticisms, Mr. Christian spoke of the pew system, and because he objects to people shutting themselves up in pews, he would alter old churches in this respect. The pew system, I admit, is objectionable. Wren even objected to it. Here is a part of a church allotted to a single person which he has the power almost of making his own freehold, and it is a right and proper thing in the Church of God that that should be done away with, but in order to do away with that, it is not necessary to clear out the whole thing. All you have to do is to take the locks off and leave the pews open; people may still sit in the old pews, but others can enter too. Mr. Christian objects and shakes his head, but I do not see it makes any matter if it is perfectly known that these pews are all free and open, whether they are high or low. Mr. Christian said he would keep things if they were works of art. But the object of my Paper was to show that being historical things, they had a value independently of their being works of art. History has got to see that things are to be preserved merely if they are pieces of the true history of that time, whether they are works of art or not. Records of all kinds are kept at the Record Office as being valuable for history. That is a new view of literature, and I hope that before long it will be a view accepted in architecture also. There is this little difference from what I said last time,* that, taking a broader view, I have endeavoured to state the great principles upon which those who oppose restorations base their argument: it is mainly on the grounds of historical interest, and that by preserving the historical interest we also preserve other beauties which restored buildings are often found not to possess.

* See, in the TRANSACTIONS, 1876-77, page 219, Mr. Stevenson's Paper on *Architectural Restoration: its Principles and Practice.* Also, at page 242 of the same volume, the late Sir Gilbert Scott's *Reply* to Mr. Stevenson's Paper, with the discussion which ensued.

VII. ELECTRIC LIGHTING. By John Slater, B.A., *Associate.*

[Read on Monday, 25th April, 1881, John Whichcord, F.S.A., *President,* in the Chair.]

THE conditions under which the profession of Architecture is practised nowadays are widely different from those which obtained a generation or two ago. Then it was not necessary for an architect to have a wider range of knowledge than would enable him to combine the materials used in building in a scientific manner, with a due regard to well known canons of architectural proportion and effect; but of late years the domain of the architect has become so enormously extended that there are few branches of knowledge with which he is not compelled to have a certain amount of acquaintance, and a familiarity with which will not afford him at times a very material amount of assistance. More particularly is this the case with scientific matters. The discoveries of science during the last few years have been so numerous and of so varied a nature—and these discoveries in many instances have affected industrial arts and manufactures in a manner totally unexpected by their discoverers, that what is only the casual experiment of the Physicist in his laboratory to-day, may a year hence cause an alteration in all our schemes of warming and ventilation; or to take another instance, the microscopical investigations of the physician in his study may lead to an entirely new system of house sanitation. Hence any discovery becomes of interest to the architect as soon as it appears likely to have a practical bearing on his work. So long as it is in the experimental stage, let the specialist keep it to himself, but as soon as it has passed this stage and reached the practical, then the architect should always be ready to avail himself of it. Electric lighting is precisely one of these discoveries: till a few years ago it can hardly be said to have come into practical use, but there are now in England and Scotland alone nearly three hundred sets of electric light apparatus successfully working, and the number is increasing almost daily. I shall attempt to show in this Paper how the architect may hope to take advantage of the discovery in his buildings, and under what conditions he will be able to use it with success.

It would be manifestly impossible within the limits of this Paper to treat exhaustively a subject upon which so many books and pamphlets have been written in nearly every European language, and I shall therefore pass over entirely all purely scientific theories as to the generation of the electric current and its transformation into light. The fact is we are only on the threshold of an acquaintance with the nature of electricity itself, and those scientific men who have made the most extensive investigations into the subject will be the first to admit how rudimentary our knowledge still is. The points to which I shall confine myself are these:—First, the means of producing the electricity; second, the various systems of electric lighting in practical use; third, the effects and advantages of the light; fourth, the cost of producing it.

But before discussing these topics, a very short résumé of the history of the invention may not be considered out of place.

Nearly 80 years ago, Sir Humphry Davy made the following experiment: he took two red-hot pieces of coal, and after extinguishing them and sharpening their points, brought them

into contact and sent an electric current through them; the two points broke into a brilliant flame, and when they were separated a short distance, the flame spread between them and assumed a slightly convex shape. This flame was named by Davy the "Voltaic arc," and the points between which it was formed were called "electrodes."* The arc is caused by the electric current continuing to pass across the interval between the carbon points, which, when first brought into contact are intensely heated; the matter begins to volatilize, and the cloud of metallic vapour and disintegrating matter appears to form a conducting medium for the current. The cost of producing the light in this way was, however, so great that Davy never dreamed of making any practical use of it, and for many years it remained nothing but a beautiful and striking experiment. In 1830, Faraday's discovery of induced electricity opened up possibilities which were soon turned to practical certainties by inventive genius. It is somewhat doubtful who was the first to attempt the application of the electric light to any practical use, but the first patent was obtained by De Moleyns in 1841. He used platinum wires as electrodes, and to obtain the cloud of disintegrating matter upon which the light of the voltaic arc largely depends, he describes an ingenious arrangement for making pulverized charcoal fall around the heated coils. In 1842, Messieurs Deleuil and Archereau conducted some experiments in Paris with very satisfactory results. So striking, in fact, were these experiments, that enthusiasts fondly imagined it would be possible to illuminate the whole of the city with four or five grand electric suns. In 1845, a Mr. King obtained a patent in the specification of which carbon electrodes are distinctly mentioned, and it is observed that, "if carbons are used, they should be inclosed in a 'Tooricelieu' (probably intended for Torricellian) vacuum," and that "two or more lights can be maintained in the same circuit," but no information is given as to how this is to be done or how the vacuum is to be preserved. The chief interest attaching to this invention lies in the fact of the explicit description of the carbons burning in vacuo, one of Mr. Edison's asserted discoveries having been thus forestalled by over 30 years. Then in 1847, a Mr. Staite, whose name appears very frequently in the lists at the Patent Office, describes "solid prisms or cylinders of charcoal ignited in air-tight vessels by a current of magnetic or voltaic electricity," but the specification is very vague and no drawings are given. Then come several inventions for producing the light by revolving discs of carbon which do not appear to have had much success. Nollet in 1850, Binks in 1853, and other inventors, obtained patents for contrivances for keeping the electrodes close together, but a very large proportion of these patents were of no practical value. The great advantages of the electric light for coast illumination were at once apparent, and the Trinity House in England, and M. Reynaud, Director of light-houses in France, took the earliest opportunity of having machines constructed for light-house illumination. The light was first permanently established at Dungeness, in January 1862, and at La Hève, near Havre, in December 1863, and experiments proved that in ordinary weather the light penetrated eight kilomètres further than the lights previously used, while in foggy weather it penetrated twice as far. Without going into further detail it may be stated that from 1841 to 1876 the total number of patents taken out in England for illumination by means of electricity was 59, in 1877 there were 28, in 1878, the year of the French Exhibition, there were no less than

* Quetelet says that Curtet was the first to observe the light between carbon points as early as 1802, but it was first exhibited in 1810, by Davy, at the Royal Institution.

145, after which year the number decreased somewhat, but the present year (1881) seems likely to prove very prolific. The foregoing is a very brief summary of the history of electric lighting.

I shall now proceed to notice, First, the means whereby the electricity is produced. When Sir Humphry Davy, in 1810, first publicly exhibited the voltaic arc the means which he used to produce it were the following: the large battery of the Royal Institution, consisting of 2000 double plates of zinc and copper, was charged with a mixture of 1,168 parts of water, 108 parts of nitrous acid and 25 parts of sulphuric acid. This was the voltaic pile, and the cost of it was very considerable. Scientific men turned their attention to the strengthening and cheapening of batteries, and Becquerel, Grove, Daniell and Bunsen achieved considerable success in this direction; but the cost of electricity produced by *any* battery was still prohibitive of its use for practical purposes, and in addition the fumes given off were exceedingly penetrative, repulsive and even dangerous. This method of generating the electric fluid was rendered unnecessary through Faraday's discovery of induced electricity in 1830. Pixii and Clark were among the earliest to turn this discovery to account, and were the first constructors of electro-motors. Their inventions were improved upon by a Belgian named Nollet, and in England by Mr. F. H. Holmes, who made machines producing a very steady and brilliant light. In France a company called the "Compagnie de l'Alliance" was formed to work Nollet's patent, and a number of excellent machines were constructed both by this Company and by Mr. Holmes. These machines were of the type called magneto-electric, that is, they were constructed with permanent magnets of steel; these, after a time, were found to become feeble, and as the machines were both cumbrous and costly, their use, with a few exceptions, has almost passed away, and a description of them is not necessary. In 1867, a discovery was made almost simultaneously by Dr. Werner Siemens, Sir C. Wheatstone and Mr. S. A. Varley, which completely revolutionized the methods of producing electricity. This discovery consisted in the fact that the residual magnetism in any piece of soft iron that had once been magnetized was sufficient to induce feeble electric currents in a coil of wire, which currents could be made to react on the iron, and thus again on the coil, till they gradually augmented the strength of the magnetic field, and the intensity of the currents in the coil finally reached a very high pitch. This discovery soon led to the invention of the dynamo-electric machines, in which small electro magnets took the place of the permanent magnets. All the more recent machines are of this type. It would be impossible to attempt to describe all the varieties which have been invented, such as Ladd's, Wilde's, Brush's, Wallace-Farmer's, &c. The two that have had the most extensive practical use in this country are the Siemens and the Gramme, the latter the invention of a French working-man with a strong taste for science, to whom more than to any one else we owe the fact that we can now get cheap electricity. As this Paper is not intended to be a dissertation on electricity it will be unnecessary to describe the details wherein the various machines differ from each other; for my purpose they may be taken to be alike, and it will be sufficient to give as simple a description as possible of the mode of action of a Gramme machine. The general principle lying at the foundation of all these machines may be thus stated:—If a magnet be brought near a bar of soft iron, surrounded by a coil or helix of insulated metal wire, a strong electric current is set up in the coil; and if the ends of the coil were attached to a galvanometer the

needle would be seen to move in a certain direction. The current is, however, very temporary, and ceases as soon as it has appeared, but if the magnet be then suddenly withdrawn another current is set up in the coil opposite in direction to the first one; that is, the needle of the galvanometer would move in a contrary direction to that in which it moved when the magnet was being brought up to the coil.

GRAMME MACHINE

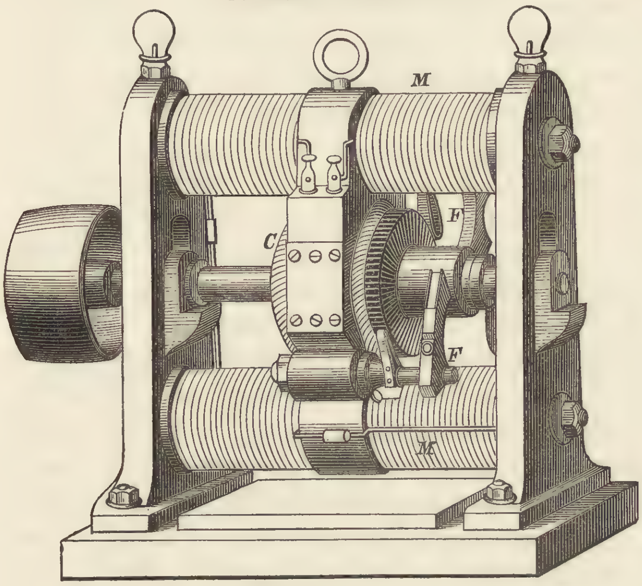


FIG. 1.

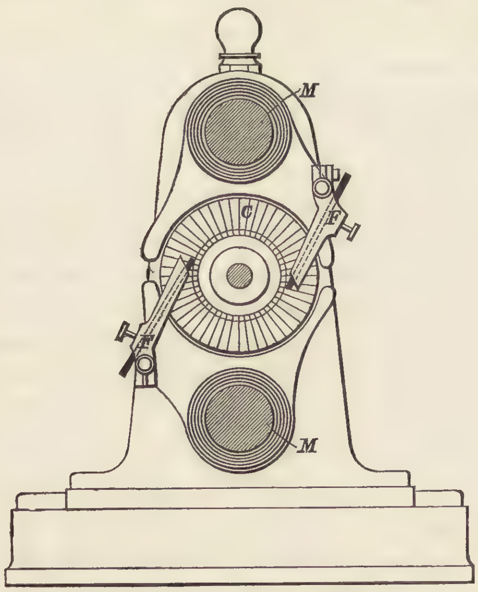


FIG. 2.

Thus, by the simple fact of making a magnet alternately approach and recede from a circuit of wire, two contrary currents are instantly created. Precisely similar results follow if the magnet remains at rest and the coil moves. In the Gramme machine, the bar of soft iron has an annular shape, and rotates between the opposite poles of a magnet. As the ring rotates, every portion of the coil above the horizontal line has currents in one direction induced in it, and every portion below that line has contrary currents induced in it, and these currents can be collected at the points of greatest potential. This, stated very simply, is the theory of the machine, and all the other dynamos do little more than ring the changes on it. Fig. 1 is a general view and fig. 2 a section of a Gramme machine. MM are the electro-magnets which are used instead of permanent ones; C is the coil rotating between them, and F F are the brushes for collecting and leading off the electricity. The Gramme machines are made in three sizes and are capable of sustaining six lights in one circuit. The Siemens machines generally use low tension currents and have a separate circuit for each light.* The chief feature of the Brush machine is that it is capable of sustaining 16

* The following memorandum relating to the Siemens system of electric lighting has been furnished by Mr. Alexander Siemens :—" The statement having been made that in their system of electric lighting

lights in circuit, but these lights are much inferior in brilliancy to those given by a Gramme machine. A machine lately invented in Switzerland, the Bürgin, and now made in England by Messrs. Crompton & Co., appears likely to prove a formidable rival to the older machines.

It is of course a very important point, for any one wishing to use the electric light, to ascertain how much of the motive force of a machine is converted into light energy, but the data on which to form a conclusion are at present very insufficient, the only reliable reports being those of the Commission appointed by the Trinity House, and of the Franklin Institute of America. The accompanying table gives the result of the investigations of the Franklin Institute Commission, but it is only fair to remark that the Gramme machine there tested was one of the earliest constructed, and that great improvements have since been made in it. Five machines were experimented on, namely, two Brush machines, two Wallace-Farmer and one Gramme.

	Weight in pounds.	Revolutions of the armature per minute.	Foot pounds of power consumed.	Horse power.	Light produced in Standard Candles.		Foot pounds consumed per Candle.	Size of Carbons.	Length of Carbon consumed per hour.	
					Total.	perh.p.			+	—
Large Brush	475	1340	107,606	3.26	1230	377	87.4	$\frac{3}{8}''$	1.78	0.34
Small Brush	390	1400	124,248	3.76	900	239	137.	$\frac{3}{8}''$	1.91	0.58
Large Wallace-Farmer . . .	600	800			823					
Small Wallace-Farmer . . .	350	1000	128,544	3.89	440	113	292	$\frac{1}{4}''$	2.45	.073
Gramme	366	800	60,992	1.84	705	383	85	$\frac{1}{4}''$	3.15	0.55

The report concludes thus:—"The Committee unanimously decide that the small Brush, though somewhat less economical than the Gramme and the large Brush for the production of light and electric currents, is, of all the machines tested, the one best adapted to the requirements of the Institution, for the following reasons: 1st. It is admirably adapted to the production of currents of widely differing intensity and produces a good light. 2nd. It is remarkable for the arrangement of its various parts, and particularly for its commutators, and in addition it is very easily repaired."

I have given this report and table because there are so few of any kind to be had; but one cannot help remarking that the language of the report is not reconcileable with the facts observed and tabulated. Judging simply by the work done and the light produced, the

Messrs. Siemens Brothers & Co. use only low tension currents, I would point out that the Siemens system comprises both high and low tension machines, and it should now be well understood that the electro-motive force of any system of electric light generators is simply a question of constructive detail, the same type of machine being wound to give either high or low tension results as desired. Messrs. Siemens do not confine themselves to either system, but employ low tension or high tension machines, as the circumstances of the lighting are more favourable to one or the other,"

Gramme machine is the best, then comes the large Brush, and the small Brush takes third place only; and it would seem as if the Committee, though feeling bound to publish the actual results obtained, allowed other considerations to influence them in their report, such as excellence of workmanship, and superior appearance. In point of fact two members of the Commission, Professors Thompson and Houston, dissented from their colleagues and placed the machines in the order I have given to them above. It cannot be too strongly insisted upon that, for practical everyday use, the most important elements of success in a machine are its economy and efficiency. The production of the electric light is simply a question of transformation of energy, and the greater the percentage of horse-power which can be utilized as light energy, the greater is the economic efficiency of the machine.* The report of the Trinity House Commission was made solely with a view to lighthouse illumination, and although the results obtained are extremely interesting, the machines experimented upon have been so largely improved since its publication, that the report has little practical value now. An exhaustive report on modern dynamo-electric machines is a great desideratum, as the whole question is by no means settled yet, and till such a report is made it is almost impossible to decide upon the comparative economy of the alternating current and the continuous current machines.

Before leaving this branch of the subject a few words must be devoted to a question which has received too little attention; and that is, how is the motive power for driving the electrical machines to be most cheaply and efficiently obtained? In a factory or mill where a good engine is working every day the easiest plan would seem to be to use it for driving the dynamos, but it is very rare to find an engine doing general work where the speed is sufficiently constant and regular. It is of the highest importance that great regularity should be maintained, or the current generated will be continually varying in intensity, and the light will never be steady; and another point is, that while the light is required the engine must *never* stop, or the whole works would be put in darkness. In most cases a small engine exclusively for the electric light will be found best, and several engineers are now making engines of from 6 to 20 horse-power specially designed for driving electric light apparatus. Gas engines are in many respects admirably adapted for the work, but they are more expensive in working than steam engines, and the light is sometimes affected slightly by the pulsations. The Otto silent gas engine generally gives very satisfactory results. Water power is the most economical when it can be obtained, as is the case on Sir W. Armstrong's estate at Craigside, where a small waterfall is utilized for turning a turbine which works the electrical machine, but such a case is of course exceptional.

Secondly, the various systems of lighting in practical use can be broadly divided into two groups: the arc-light systems, and the incandescent systems. The arc-light systems are again

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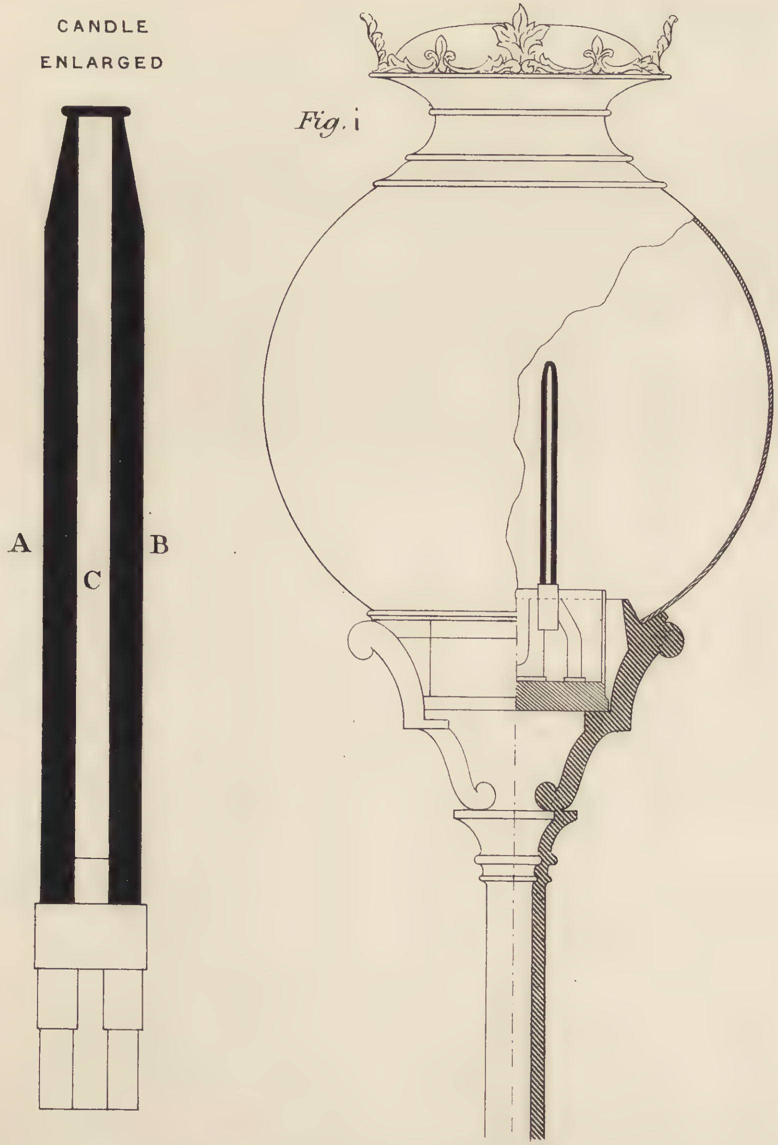
* With reference to this report the following remarks of the Count Th. du Moncel are very much to the point:—"Nous croyons que, malgré l'importance de ces documents, la question est loin d'être résolue, et nous trouvons que, dans ces différents travaux, l'esprit de nationalité joue un trop grand rôle pour qu'on puisse s'y fier aveuglément. D'un autre côté, il est impossible de se fier aux chiffres donnés par les différents constructeurs et inventeurs de ces machines. Outre que la plupart n'ont pas les connaissances scientifiques nécessaires pour donner des résultats exacts, il est certains intérêts personels dont il est impossible de faire disparaître l'influence dans les assertions émises, et quant à moi, je crois qu'il faut retrancher beaucoup des résultats annoncés."

ELECTRIC LIGHTING, (Nº 14.)

CANDLE
ENLARGED

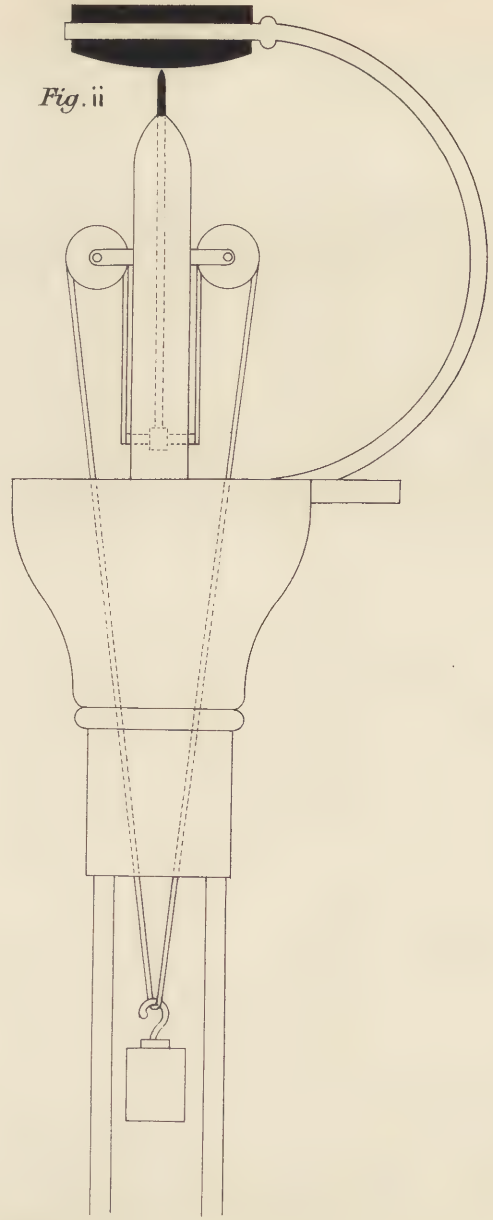
Fig. i



ALTERNATING CURRENTS.

JABLOCHKOFF LAMP.

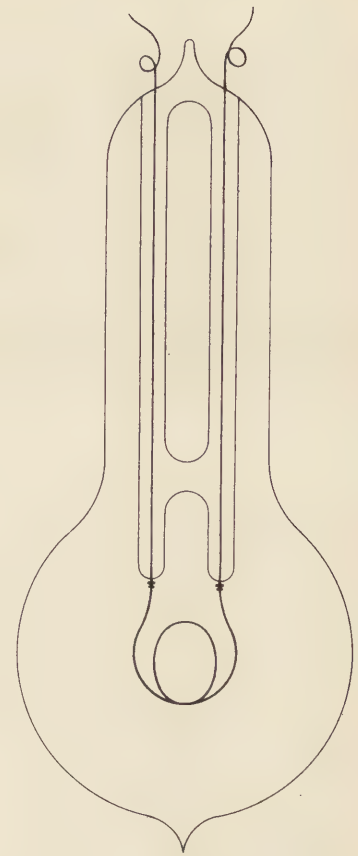
Fig. ii



QUASI-INCANDESCENT.

WERDERMANN LAMP.

Fig. iii



INCANDESCENT.

SWAN LAMP.

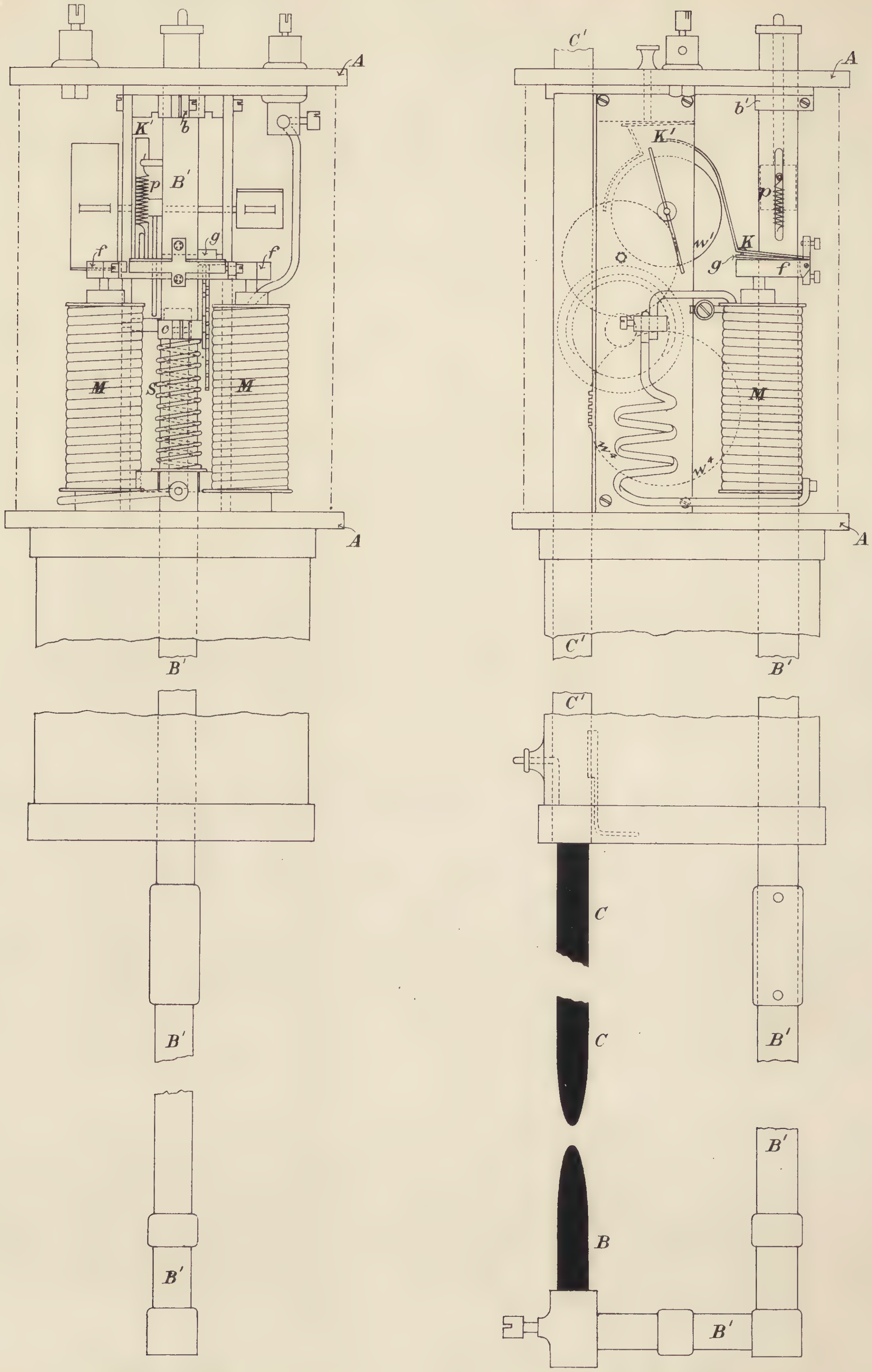
C.F. Kell Lith. Castle St. Holborn, London E.C.

divisible into two branches: (*a*), those using alternating currents; and (*b*), those using continuous currents. The principal lamps using alternating currents are the Lontin, Rapieff, Wilde, Jamin, Jablochkoff, and some of the Siemens lamps; and I shall select the Jablochkoff for description, partly because of its wide-spread renown, and partly because the system can be so readily examined in London, on the Embankment, at the District Railway Stations, and at other places. In this system the two carbon electrodes A and B (see Illustration, No. 14, fig. i) about 4 millimètres in diameter are separated by a thin lamina of insulating substance C which keeps the carbons electrically separate. This lamina was originally of kaolin or china clay, but lately plaster of paris has been used, and the strips are about two millimètres thick. On the top a thin layer of carbon or black-lead and gum is laid as a sort of bridge from one carbon to the other. At their lower end the carbons are provided with a copper holder through which the current passes to the carbons, and a solid clamp encloses the tubes, holding them rigidly so that the carbons are always kept in the same relative position. When the current passes, the small carbon bridge is immediately consumed, the points of the electrodes glow with an intense heat, and the intervening plaster of Paris volatilizes, and by its light increases that given off by the carbons. This combination of the carbon electrodes with the insulating substance has received the name of the Jablochkoff "candle," but it has been discovered that the insulating lamina of plaster of Paris is not essential to the candle, as the two carbons will furnish a good light by themselves. Any alternating machine can be used with this system, but the best results are obtained by the use of a modification of M. Gramme's continuous machine. The carbons and holders are inclosed in a ground glass or opal globe and the lamp is complete. In consequence, however, of the small size of the carbons, and the rapidity with which they are consumed, it is necessary—when the lamp is to continue burning for several hours—to have more than one candle inclosed in the globe, and by a simple arrangement of levers, as soon as one pair of carbons is nearly burnt out the current is automatically shifted to the next pair, and so on. In each of the large lamps used for lighting the Opera House in Paris, in 1878, there were no less than six candles, but four is the number generally used. These extra candles are the cause of the shadow on the globe which may frequently be observed when the light is burning. The great advantages of the Jablochkoff system are its simplicity, as no regulating machinery is required to keep the carbons the proper distance apart; the small size of the lamp, the carbons being placed parallel, and not one above the other as is the case in regulator lamps; the equal burning away of the two carbons in consequence of the alternating character of the currents, whereas when these are continuous the positive electrode burns away much more quickly than the negative; and the manageable character of the light which is not too brilliant to be brought comparatively close to the eye. But against these advantages there are several drawbacks to set off. In the first place the light is noisy, resembling the buzzing of a number of flies, and although this would be of small consequence in the open air, it would be very unpleasant in a room. The noise is caused by the constant succession at extremely short intervals of the alternating currents, which cause the light to be extinguished and relit at each change of direction. Of course these changes are much too rapid to be appreciated by the eye, but the minute reports reach the ear as a continuous sound. Another objection is that the rays from the Jablochkoff lamp have frequently a very marked blue or violet tinge which is most unpleasant. Then again, if

once the current happens to cease for a second the lamp is extinguished, and cannot be relit without being taken down and adjusted. But the main obstacle in the way of an extensive practical use of the system is the fact that alternating currents produce light at a much greater cost of power than the continuous ones. This is now generally admitted—although it is almost impossible to measure the intensity of these currents—and it is in accordance with all the laws which hold good with other modes of the display of force and motion. When motion is stopped, inertia has to be overcome before it can be renewed, and a certain amount of force must be expended in overcoming this inertia. I am quite aware that electricians will ridicule the notion that there can be such a property as inertia in electricity, but there can be no doubt that there is a something, resembling in its effects inertia in matter, which causes it to be less wasteful to use currents continuous in direction, than to use those which are continually changing. The generally received opinion is that the continuous currents give about 30 per cent. more useful effect at the arc—that is as far as light is concerned—than the alternating currents. Unless further experiments and wider knowledge should tend to modify this opinion, it will be hopeless for these systems to compete with the more economical ones. One other very great drawback to the alternating currents is that they are undeniably dangerous. All the fatal accidents that have been reported in connection with the electric light have occurred with alternating systems, while the nearest approach to an accident with continuous currents, was a slight shock experienced by the engineer of the Brush Company while attending to one of their lamps.

I now pass to (*b*) the systems using continuous currents such as the Serrin, Siemens, Brush, Crompton, Maxim and others. It will be necessary for a moment to recall attention to the nature of the voltaic arc. The two carbon electrodes, after being brought into contact, are separated for a short space, and the electric light plays between the two. Now, for the light to be perfectly steady, two conditions are necessary: that the current should remain of the same strength in itself, and this can be only partially secured by keeping a perfectly regular speed on the engine driving the electric machine; and that the resistance to the current remain constant, the chief essential to this being that the distance between the carbon points remain the same, so that, in an ideally perfect regulator lamp, the two carbons would keep on moving towards one another at precisely the same rate as that at which they were being consumed. But on no two occasions can a precisely similar strength of current be insured, so that it would be useless to have a regulator moving the carbons together at a *fixed* rate of speed. What is wanted is a mechanism, the movements of which will respond instantaneously to the slightest variation in the strength of the current, and it is to the attainment of this end that all inventors of regulator lamps have directed their energies. This mechanism, by which the carbons are kept the proper distance apart, varies in different lamps; the Serrin was one of the earliest invented (I am purposely leaving out of the category those like the Duboscq which are used almost solely for laboratory work), the Suisse-Serrin was an improvement on this, and the Siemens lamp—particularly those that have been lately constructed—came still nearer to meeting the conditions of a perfect lamp, but as a type of the class I shall select for description the Crompton regulator lamp, partly because of all that I have examined this gives the steadiest light—and this opinion has been confirmed by numerous other observers—and partly because it is of recent invention and has been rarely

ELECTRIC LIGHTING, (Nº 15.)



BACK VIEW SIDE VIEW.

CONTINUOUS CURRENTS.

CROMPTON REGULATOR LAMP

C.F. Kell, Lith. Castle St. Holborn, London. E.C.

described in public. The chief merit of this lamp is that in it the governor which controls the advance of the carbons has been reduced to the smallest possible dimensions, so that it can be made to alter its position of stability by the application of the very slightest force. This lamp is shown in Illustration No. 15. The upper part containing the mechanism consists of a pair of top and bottom plates A A united by a pair of flat frame plates which form the sides carrying the train of wheelwork. This part is covered in by a glass cylinder held at top and bottom by grooves in the plates. B is the lower carbon, and B′ its holder which plays through two holes in the framework of the lamp, which permit it to move vertically through a certain distance which is regulated by a collar *b′* affixed to the carbon holder. When the lamp is not working, this collar is kept pressed up against the framework by a strong spring S acting on a collar *c*. C is the upper carbon and C′ its holder, which consists of a long brass rod which descends by its weight towards the lower carbon, but its descent is controlled by a rack cut in it, the teeth of which are geared into the wheel W^4 which is the last of a series of wheels and pinions, of which the fly-wheel W^1 is the first. These wheels are proportioned so that one revolution of the break wheel corresponds to a descent of the upper carbon of ·1 millimètre. M.M. are the electro-magnets through which the current passes when the lamp is at work, and in close proximity to these magnets is an armature *f* firmly fixed to the lower carbon holder. When the current passing through the lamp is powerful enough to give a proper light, the magnets attract this armature, overcome the resistance of the spring S and pull the lower carbon holder down, so that the two carbons are separated and the arc is formed. On the upper surface of the armature is hinged a very light soft iron plate *g* carrying a curved arm KK′ so shaped and adjusted that when the armature *f* rests on the core of the electro magnet and the plate *g* is pulled down on to the armature, the curved arm KK′ presses upon the edge of the fly-wheel W^1 and prevents its rotation. Under ordinary circumstances the plate *g* is kept away from the armature by a fine spiral spring *p* which can be adjusted to the strength of the current, so that when the lamp is burning under normal conditions, the piece *f* is just on the balance. As the carbon points burn away and the current becomes weakened, the spring *p* overcomes the attraction of the armature on the piece *g*, the curved arm is lifted off the fly-wheel, allowing it to revolve, and a feed takes place. It will be noticed that the only piece which requires to move, when a feed is to take place, is the small iron plate *g*, and thus greatly increased delicacy is obtained in the feed of the lamp. When two or more lamps are required to be burnt on one circuit, the spring *p* is replaced by a small electro-magnet connected with the main leading wires as they enter and leave the lamp.

When the current ceases the light of course goes out, the large electro-magnets M.M. cease to attract the armature *f* and the lower carbon holder springs up, the carbon points touch and everything is ready for a fresh kindling. This description will apply with slight variations to other regulator lamps. These arc lights are generally of too great brilliance to be used without shades or lanterns, of which various shapes and sizes are constructed.

For these, and in fact for all such lamps, good carbons are essential, and much ingenuity has been displayed of late years in their manufacture. At first the coke from gas retorts was tried, but carbons made from this substance were not very pure and could not be relied on to give a steady light. It is very important that they should be homogeneous, and of the same texture throughout, so that one part does not offer greater resistance to the current than

another, or intense heat will be developed at the refractory point; they should be hard, not noisy, and should throw down no ash. M. Jacquelain in 1858 thought he had solved the problem of their construction, and many of his carbons appear to have been all that could be desired, but there was no uniformity in them, and bad ones were as numerous as good. Gaudoin before his death manufactured some excellent carbons, which gave a beautifully white light. Some English electricians still possess specimens of Gaudoin's carbons, but no one seems to have taken up the manufacture at the death of the original inventor. In 1876, M. Carré took out a patent for making carbons of a mixture of finely powdered coke, lampblack, and syrup of molasses, and these carbons are now made in Paris on a very large scale. Messrs. Siemens Brothers & Co. have established works for manufacturing carbons at Charlottenburg near Berlin, and also at Woolwich, where upwards of 10,000 feet of each sort can be produced per week. These carbons are, however, very irregular in their resistance: it is no unusual occurrence in the British Museum Reading Room to see two lamps side by side, one of which is burning with a pure white light and perfectly steadily, while the other is never still and gives out a preponderance of purple and violet rays. The house of Messrs. Sautter and Lemonnier in Paris supply perhaps the best of all, but they do not make them of larger diameter than 15 millimètres. Various experiments have been made from time to time in order to test the effect on the light of the carbons of the amalgamation with them of various metallic salts, such as phosphate of lime, chloride of calcium, phosphate of magnesia, &c., but it was found that though in some instances the light was slightly augmented, there was frequently a great increase of smoke which was far from satisfactory. The effect of coating the carbons with a very thin layer of some metal, such as copper or nickel, was more satisfactory; in fact the Brush Company, who make carbons for their own lamps, habitually copper-plate them, but there is evidently great room for further experiment and improvement in this branch of electric lighting. It has been already remarked that, with continuous currents, the positive or upper carbon burns away at a faster rate than the negative or lower one; and this peculiar feature is presented: namely, that the upper carbon is hollowed out at its point into a small concavity called the crater. Experiments have shown that this crater is of great advantage for lighting floor spaces, and in nine cases out of ten this is what is wanted, as the cavity becomes like a glowing sun, and sheds down at an angle of about 60 degrees considerably more light than all the rest of the arc: calculations have been made showing that about 75 per cent. of the total illumination comes from the upper carbon. For any lofty hall or workshop, for a theatre, or for such a lecture-room as that of the Institute, a lamp such as I have described would be admirably adapted, but it would be too intense for lower rooms and for private houses, for which another system, namely, the incandescent, will be found more suitable.

Before describing the incandescent system proper, the quasi-incandescent systems must be noticed, the chief being those of Reynier, André, Werdermann and Joel. These systems are a compromise between the arc and the incandescent systems. One of the carbons, either the positive or the negative is made of a very large size and the other very small, and when the smaller carbon is brought quite close up to the larger one, the current passes, an extremely short arc is formed, and the small carbon glows with an intense brightness which is maintained as long as the two carbons are kept almost in contact: the large carbon scarcely burns away at all. Fig. ii. (see Illustration No. 14) is a view of a Werdermann lamp, where the small positive

electrode is placed underneath a large disc-like mass of carbon forming the negative electrode. The small carbon is kept pressed up against the large one by a counterweight and an arrangement of pulleys. The results attained by this lamp are stated to be very satisfactory, but the applications of the system have hitherto been so few that it can hardly be said to have passed the experimental stage. Quite recently, however, a lamp has been brought before the public which is a vast improvement on the Werdermann. This has been invented by Mr. H. F. Joel, and for steadiness, moderate brilliancy and great purity, it is hardly surpassed by the incandescent lamp, properly so-called. In this lamp one electrode is of carbon as in the Werdermann, but the other is a fixed disc or cylinder of copper against which the carbon rod is kept continuously pressed up by a simple arrangement of balance weights. The action of the electric current causes the top of the rod to curl over in a peculiar way, so that a sort of mushroom is formed at the point which wears away and is continually renewed. The copper electrode does not wear away at all or very slightly. This lamp can be arranged either as a chandelier with the carbon rod pressing down on the copper or as a pillar lamp with the carbon pressing up, and the light is equally good in each case. Any number of the lamps can be burnt in one circuit provided the electro-motive force be sufficient.

The principal incandescent systems are those of Sawyer-Mann, Lane-Fox, Edison, Swan and Maxim. Lighting by incandescence is a much simpler affair than arc lighting as nothing more is required than some highly refractory substance, non-fusible, and that can be formed into a thin lamina, which will glow with a white heat when the electric current is sent through it; and the only suitable substances are platinum, iridium and carbon. In describing the incandescent system of electric lighting no one can pass over the name of Mr. Edison, or avoid paying a tribute of admiration to the marvellous inventive genius displayed by him in numerous ways. As the inventor of one form of the telephone and the constructor of the phonograph—perhaps the most wonderful production of the nineteenth century—Mr. Edison has made a reputation second to none, and there has probably never existed a man whose inventive skill is so widely renowned or has exercised so great a fascination. The inventor himself is said to be one of the most modest and retiring of men, but it is much to be desired that his admirers could restrain within due limits the enthusiasm with which his achievements have inspired them. Time after time, within the last few years, have messages been flashed under the Atlantic, stating that problems connected with electric lighting, the solution of which had baffled the ingenuity of all the scientific men of the Old World, had been solved without the possibility of doubt by the mechanician of Menlo Park; and the effect of one of these telegrams upon the gas shares of nearly all the largest companies in England and France, was one of the most extraordinary phenomena ever witnessed. The effect was but temporary, as the revolution heralded with such a flourish of trumpets has hitherto turned out to be a mere flash in the pan. It was asserted that Mr. Edison had found a means of almost indefinitely subdividing the electric current so that a large number of lights could be burnt on one circuit, and had also discovered in an alloy of platinum and iridium a substance that would bear any amount of heating without being fused or consumed. It has, however, lately become generally known that further experiments led Mr. Edison to abandon this alloy as unsatisfactory, and to fall back upon carbon as the most promising substance to employ. The world still waits the practical solution of the problem at Mr. Edison's hands. In this country since 1845, when

Mr. King obtained a patent for an incandescent lamp, but little progress was made in this direction till about three years ago, when Mr. Swan of Newcastle, who twenty years earlier had actually constructed an incandescent lamp, using carbonized paper, was induced by circumstances to pursue the subject afresh, and the result has been most successful. Mr. Swan's lamp, which is shown at fig. iii. (see Illustration 13) is simplicity itself. It consists of a hollow glass globe terminating in a duplex tube through which the two wires from the circuit pass. The interior of the globe is rendered as nearly as possible a perfect vacuum, the creation of which was much facilitated by a recent invention, the Sprengel air pump. Everything depends upon this vacuum being thoroughly preserved, and leakage is guarded against by coating the wires with glass almost up to the carbon and by fusing the glass round the wires. The ends of the wires in the globe are connected by an extraordinary thin filament of carbon—a mere hair, which is, however, very strong, hard and elastic. When the electric current passes, this filament glows with a beautifully steady yellowish white light—not so white as the arc light—but still whiter than gas, and this slight tinge of yellow will by many persons be considered an improvement. Although the carbon glows with this intense heat it is not consumed, as oxidation does not take place, the vacuum being so good, and there is no reason why the lamp should not last for years unless broken by accident. Several of these lamps can be combined in a chandelier, and any number can be burned on one circuit so long as there is sufficient electro-motive force. Here then the grand difficulty of the division of the electric light has been overcome, and I am confident that if electricity is to be applied to our private houses for lighting purposes it will be in some such form as this, as no one could desire a more beautiful light. Mr. Lane-Fox's lamps are very similar, the chief difference being in the method of effectually preserving the vacuum.

Thirdly, the applications of the electric light are so numerous and of so varied a nature that it would be impossible to discuss them all. I shall therefore say nothing of its use in public streets, lighthouses, vessels of war, mines, or for military purposes or marine signalling, in all which cases its advantages are manifest; I shall confine myself to its advantages and effects in buildings and for building operations. To take the latter case first it is evident that the architect has here ready to his hand a means whereby works of great importance and urgency can be carried out in little more than half the usual time required for them. All who have had experience of compulsory nightwork carried on by the aid of large flaring gas jets, which are frequently placed in the most awkward situations and are never steady, will have a keen appreciation of its unsatisfactory nature and want of safety; frequently also nightwork is required in localities far removed from any gas works, so that gas cannot be obtained at all; but with the electric light nightwork can be carried on in any locality quite as well as by daylight and without the slightest risk. No pipes are required, there is no danger of leakage, the wires can be carried in any direction and for long distances without any support, and if the lamp is slung on the top of some scaffold poles and provided with a reflector, a very large area can be illuminated by one lamp. Engineers will probably avail themselves of the light for this purpose to a greater extent than architects, but for both it supplies a great want, and some electrical contractors have already announced their readiness to put up temporary apparatus if required.

It is, however, with the interiors of buildings that architects are mostly concerned. The conditions necessary to be observed, in order to effectually illuminate the interior of a building by artificial means, are not so simple as might be imagined and vary with the

requirements of each individual case. The scheme of illumination for a dining room should differ from that of a drawing room; the lighting of a large reading-room should be planned on principles quite different from those that should govern that of a lecture-hall or theatre. In the one case the light should be concentrated on one or more separate points, while the other parts of the room may be in comparative obscurity; in the other the whole light should be diffused as completely as possible so that every portion of the room may be equally and effectually illuminated. Even on a brilliant summer's day the actual direct rays of the sun give a very small proportion of the light which we enjoy: every cloud, every building and the surface of the earth itself, act as a reflector and help to diffuse the light, so that all objects are more or less equally illuminated on all sides. As a general rule it may be laid down that the nearer we can approach to the effect of natural daylight in our artificial illumination the better it will be, for the cases in which a diffused light is required are far more numerous than those where concentration is to be aimed at. The electric light has been shown by the spectrum analysis to be precisely similar in composition to that of the sun; and if a moderate light is wanted in several places it can be provided by Mr. Swan's lamps, while one of the arc regulator lamps, with a judicious arrangement of reflectors, will give a beautifully white diffused light over a large area. This question of suitable reflectors appears to me to have a most important bearing upon the future of the light. No one wants to look at the light itself, and whenever the large arc lights are used in situations comparatively near the eye, semi-opaque shades have to be employed to enable the eye to bear their brilliance, and hence ensues a great waste of power; but if the lamp were hung a few feet away from the ceiling of a room, and the flame itself hidden and reflected upwards upon the white surface of the ceiling, the result would be a diffused light over the whole room, much more agreeable than that given by the lamp itself. Some such system as this has been adopted at the Terminus of the Chemin de Fer du Nord, in Paris, and at the Picton Reading Room, in Liverpool, but there I am informed the result is not altogether satisfactory. Again, by a suitable dioptric arrangement with reflectors at the requisite points, one lamp could be utilized for lighting corridors running in various directions, and thus the division of the light would be rendered unnecessary. Sir W. Thomson in his evidence before the Parliamentary Committee hinted at the great increase of usefulness of the electric light that would result from a careful study of the effect of reflectors.

The *advantages* of the electric light over gas or oil are beyond question. For instance, as to quantity or illuminating power. Now photometry can scarcely be called one of the exact sciences. In this country we use as a standard the light of a sperm candle of six to the pound; in France the unit of measurement is a Carcel lamp burning 42 grammes of purified colza oil per hour, and this lamp is as nearly as can be ascertained equal to 9·6 candles. The estimation of a light varies greatly according to the angle at which the comparison is made; much also depends upon the individual, and very much on the colour of the light; and the difficulty of making accurate comparisons is considerably increased when one of the lights is greatly in excess of the other. Professor Tyndall has stated his opinion that it would be impossible to compare the electric light with one or two sperm candles.* In the experiments made at the South Foreland Lighthouse, it

* The following remarks on this subject are taken from a Paper read before the Institution of Mechanical Engineers by Dr. John Hopkinson, F.R.S.:—"The measurement of the light emitted by an electric arc presents

was found that the electric light was equal to 8·31 times that of the large six-wick Trinity oil lamp, which itself was equal to 722 candles, so that this would give 6,000 candles as the value of the light. In 1877, M. Tresca reported to the Académie des Sciences in Paris that the light given by a Serrin lamp, driven by a Gramme machine making 1,000 revolutions per minute, was equal to that of 1,860 Carcel lamps. This is enormous and a far brighter light than could be comfortably managed in any building. The arc lights in general use for industrial purposes vary from 2,000 to 8,000 candles. The Jablochkoff light when naked varies from 300 to 450 candles, and when a globe is interposed about 40 per cent. of light is lost. Each of Mr. Swan's little lamps gives a light of from 30 to 40 candles. These powers, especially of the large lamps, are for the reasons previously stated not altogether reliable, and Mr. Preece has suggested that lights should be rated as capable of illuminating a certain floor area to a certain standard. Mr. Crompton in carrying out this idea has suggested the following standards: (*a*) the area in which any fine work can be carried on; (*b*) that over which a newspaper can be read comfortably; (*c*) that in which all parts are rather better lighted than by a full autumnal moon. The accompanying table, kindly furnished me by Mr. Crompton, will give some notion of the intensity of the electric light when tested under these conditions. It will be observed that the higher the light is placed the more effectual it is. The power of the electric light to penetrate fog has been clearly established by numerous experiments.

Places Lighted.	Nominal Candle Power and actual Horse-power required per Light.	Height of Lamp above Ground.	Standard.	Area illuminated in sq. yards.
Stanton Iron Works, New Foundry . .	4,000 candles, 2½ H.-P. Gramme . .	18 ft.	*a*	530
" " " Fitting Shop . .	4,000 " 2½ " " . .	20 "	*b*	1,100
St. Enoch's Station, Glasgow	4,000 " 2¾ " " . .	43 "	*b*	2,000
Alexandra Palace Groves	4,000 " 4 " " . .	40 "	*c*	9,000
Liverpool Street Station, London . . .	2,000 " 1 " Brush . . .	18 "	*c*	1,400
Blackpool Promenade and Pier	6,000 " 4 " Siemens . .	60 "	*c*	97,000
Barden Works	8,000 " 9 " Gramme . .	80 "	*c*	280,000

certain peculiar difficulties. The light itself is of a different colour from that of a standard candle in terms of which it is usual to express luminous intensities. The statement without qualification that a certain electric lamp and machine give a light of a specified number of candles is therefore wanting in definite meaning. A red light cannot with propriety be said to be any multiple of a green light; nor can one light which is a mixture of colours be said with strictness to be a multiple of another unless the proportions of the colours in the two cases are the same. . . . The fact that the electric light is a very different mixture of rays from the light of gas or of a candle has long been known, but has been ignored in statements intended for practical purposes. Again the emission of rays from the heated carbons and arc is by no means the same in all directions. Determinations have been made in Paris of the intensity in different directions in particular cases. If the measurement is made in a horizontal direction, a very small obliquity in the crater of the positive carbon will throw the light much more on one side than on the other, causing great discordance in the results obtained."

Then, as to the quality. Everyone is aware that in gaslight the yellow rays largely predominate, so that it is impossible to distinguish blues, greens and delicate shades of other colours: the consequence is that the decoration of rooms that have to be used at night must imperatively be in strong tints not suitable for daylight. The reason why the yellow rays are in excess in gaslight—in other words why the light is very impure—may be shortly stated thus: When a substance is heated, a large number of heat rays are given off which are invisible; as the temperature rises the substance begins to glow, at first with a dull red heat which commences at about 977° Fahrenheit; the red then passes into orange and yellow, and it is only at a very high temperature indeed that all the colours of the spectrum are emitted and white heat is produced; the violet rays appear at about 2,012° Fahr., but these rays though produced by such intense heat have much less heating power than those of lower refrangibility. Now the invisible radiation in burning gas is very great and the combustion is never sufficient to produce more than a yellowish light; in the electric light on the other hand, although the invisible radiation exists to a certain extent, it is much less than that of gas, and the heat developed at the carbon points is so intense that a light of great whiteness is produced, in which all the most delicate shades of colour can be accurately distinguished. Hence in shops and factories where coloured goods have to be examined at night the light is invaluable. Mr. Frederic Shoolbred, of the firm in Tottenham Court Road, stated in evidence before a Parliamentary Committee that, before the introduction of the light at his establishment, all work requiring matching of colours had to be given up as soon as the gas was lit, but with the electric light the colours were perfect. In picture galleries also the use of this light would enable thousands of persons to enjoy the exhibitions far more than is possible now, when the colouring of many pictures is quite spoilt by gaslight. The effect of gaslight is also extremely hurtful to the surface of oil paintings, in fact after the last winter exhibition of the Old Masters at the Royal Academy many of the pictures were in such a state that it was almost impossible to clean them, and I have been informed that many members of the Royal Academy are strongly of opinion that some method of lighting the galleries by electricity should be adopted before the next winter exhibition. If the light were generally introduced, ceilings would not become blackened nor gilding and other decorations tarnished, and the danger of fire would be reduced to a minimum.

Notwithstanding the great heat between the carbon points, a very small quantity of this heat goes to raise the temperature of the air in the neighbourhood of the lamp, hence all rooms would be much cooler when electricity is used than under the present system of lighting. The explanation of this fact, which at first appears very astounding, has been hinted at already, and it may be taken as an axiom that the heat of the rays given off by a burning body is in inverse proportion to their luminosity; so that the voltaic arc emits the largest amount of light with the least quantity of heat. I have carefully calculated the amount of heat given off by one of the large arc lights, and it is 42·7 units per minute: a gas burner using 5 cubic feet per hour gives off 48·3 units per minute.* Hence an ordinary gas burner radiates into a room more heat

* In making this calculation it is assumed that $2\frac{1}{4}$ total horse-power per light is indicated at the dynamo machine; various tests have shown that about $1\frac{1}{4}$ horse-power is absorbed in the machine itself, so that only one horse-power is reproduced as light. Now one horse-power $= \frac{33{,}000}{772} = 42{\cdot}7$ heat units per minute. One cubic foot of coal gas gives off 580 units of heat; $\because$ a burner consuming 5 cubic feet per hour gives off $\frac{580 \times 5}{60} = 48{\cdot}3$ units per minute.

than one of the large arc lights in the proportion approximately of 8 : 7. The great advantage of this in rooms for public assemblies is evident. One curious and unexpected result of the use of the electric light will probably be that the acoustic properties of a room will be immensely improved. Professor Tyndall, in his experiments on fog-signalling, found that the waves of sound were interfered with far more when they had to pass through atmospheres of different densities than when the density was the same. The heated currents of air in a gas-lit concert-room must cause the formation of strata of varying density; in other words must destroy the homogeneity of the medium conducting the sound, and this is probably the cause of the complaints which are frequently made of the different acoustic properties of a room when used at night and when used in the daytime. It has always been a more or less difficult task to render public buildings acoustically satisfactory, and although as yet the cases, in which the electric light has been used in interiors, are too few to enable any accurate details to be given—in fact I am not aware of any experiments having been made with this view—what we know of the laws of sound tends to raise the expectation that in electricity the architect will find a valuable acoustic ally.

The adequate ventilation of all rooms private and public, but particularly the latter, when used for large assemblies by gaslight, has always offered a problem to our profession difficult of solution. In addition to the oxygen consumed, and the carbonic acid given off by the persons assembled, there has been the abstraction from the air of the oxygen required to support the combustion of the gas; and it has been calculated that in a well-lit hall the gas consumes four or five times as much oxygen as the people. Until the discovery of the electric light it was impossible to produce artificial illumination without the chemical combination of the oxygen of the air with the burning body giving the light. But with electricity the conditions are quite different; the light is equally brilliant in a vacuum and in the air, and with the incandescent systems no oxygen whatever is consumed by the glowing filament of carbon. With the arc light there is a slight consumption, but how slight it is the following calculation will show. The best carbons of 13 millimètres diameter, giving a 4,000 candle light, burn away at the rate of about 3 inches per hour, and the average weight of this amount of these carbons is ·79 oz., so that in three hours 2·37 oz. of carbon would be consumed, and the weight of oxygen that would have to be abstracted from the air to support this combustion would only be $\frac{2{\cdot}37 \times 32}{12} = 6.32$ oz., which is in volume 4·71 cubic feet. With ordinary coal gas of good quality a light equal to 15 candles can be obtained by the consumption of 5 cubic feet per hour (as a fact the gas generally supplied by the gas companies of London rarely gives 14 candles for 5 feet per hour), therefore to obtain a light of 4,000 candles for three hours would necessitate the consumption of 4,000 cubic feet of gas, and the amount of oxygen which this gas would abstract from the air during combustion would be $4{,}000 \times 1{\cdot}17 = 4{,}680$ cubic feet, or just about 1,000 times as much as the electric light would take. In the Albert Hall it was ascertained by actual measurement that 43,000 cubic feet of gas were burnt when the hall was not lit by electricity, and this would represent over 50,000 cubic feet of oxygen consumed. No words are necessary to show how vastly more simple becomes the problem of securing efficient ventilation when we have got rid of this enormous consumption of oxygen, which must be replaced as rapidly as it is drawn off if the air is to remain fit for respiration. The use of the electric light thus preventing the vitiation of the atmosphere, it would not require renewal so

frequently, consequently fresh air could be introduced much more slowly than is possible under existing conditions, and one most desirable result of this would be the diminution of draughts. The introduction of the electric light would be attended with equally beneficial results in private houses, workshops, factories, &c., and a great improvement in the sanitary condition of the workpeople employed in them must ensue. The amount of absolute disease engendered by the constant inhalation of vitiated air caused by burning gas is enormous, but this aspect of the question concerns medical men more than architects, and I can only allude to it here.

That objections should be urged against the electric light is natural. Every new invention has to overcome a certain amount of prejudice. It is asserted that the flickering of the light and its intense whiteness are injurious to the eyesight. When the light was first introduced, the flickering and noise were decided drawbacks, but improvements in the regulator lamps have greatly diminished these faults, and no steadier or quieter lamps than the incandescent lamps of either Mr. Swan or Mr. Lane-Fox or Mr. Joel could be wished for. As to the intense whiteness injuring the eyesight it may be replied that light is not intended to be itself looked at, but to enable us to see other things. A close observation of even a brightly burning gas flame would temporarily paralyze the optic nerves. But the injury to eyesight caused by the electric light has been greatly exaggerated. There can be no doubt that our eyes have become so accustomed to the yellow flame of gas that a white light is at first wearisome and gives a certain coldness of aspect to everything illuminated by it, but it is astonishing how soon this sensation wears off, and if the yellow tint is deemed so very desirable it can be given to the electric light at any time by using tinted glass for the globes.* Then again it is objected that if electric lighting become general there will be great risk of accident from the fusing of a wire, or from shocks given to those persons who have to attend to the lamps. As to the first cause of accident the risk is quite infinitesimal, and far less than that attaching to gas lighting; in fact the Fire Insurance Companies have publicly notified their conviction that electricity, as a mode of obtaining light, is much safer than gas. As regards shocks from the electric currents the risk is practically *nil*. The electric current can be switched off from any lamp, or series of lamps, so easily that their manipulation would not require so long to understand as that of gas-burners and taps. The recent terrible fire at the Opera House at Nice is a striking example of the great danger of gaslighting unless the greatest possible amount of attention is given to all pipes, taps, &c. Here the first slight explosion of gas, besides setting fire to the curtains, &c., plunged the whole house in darkness, whence arose the fearful panic which caused more deaths from suffocation than from actual burning. Had electricity been employed as a separate source of light in parts of the house only, darkness would not suddenly have supervened and much loss of life would have been prevented. When one reflects upon the many explosions of gas which take place, the abominable smells caused in our houses by leaky pipes, the nuisance arising from meters being frozen in sharp weather and the supply of gas cut off—when one considers that with the electric light none of these nuisances would occur, the slight objections to it are outweighed a hundredfold by its advantages already enumerated, of which the luminous intensity is the least for architectural purposes. The improvements that have been made in gas-burners enable us to obtain practically as much light for our interiors as

* In the British Museum Reading Room amber glass reflectors are used.

is desired, but no possible improvements in gas-burners can make gaslight other than extremely heating to the atmosphere of a room, or prevent its combustion from removing from the air an enormous quantity of that element which is absolutely essential to respiration.

Fourthly, the cost of the electric light has a very important bearing upon its practical use. Numerous calculations have been published by persons interested either for or against the system, but the majority of these are so manifestly exaggerated on the one side or the other that I have thought it better to embody in this Paper no details of cost that have not been proved in actual working. The question is not so simple as might be imagined. For a fair comparison of the cost of the electric with any other system of illumination, account should be taken of the cost of introducing it, of the coal or other fuel used for driving the machines, skilled attendance and other matters. A great deal will depend upon the motive power used for generating the electricity. Where water power is obtainable, the cost will be extraordinarily low, but of course this is only an exceptional case, though I may remark in passing that the researches into the nature of the electric light have led to a most interesting discovery, namely, the possibility of transmitting motive power by means of electricity; and it is not a very hazardous prediction that, before many years are passed, practical schemes will be introduced for utilizing the enormous latent power of the tides or of waterfalls—which is now wasted—for the purpose of driving machinery many miles away from the spot where the force is developed. Steam comes next to water power in economy, and here everything will depend upon the kind of dynamo machine used, that being the most economical in which the horse-power expended bears the smallest proportion to the light-intensity measured; and in any comparison of machines particular attention should be paid to the angle at which the light-intensity is measured, the candle power of an arc-light being four times as great when measured at an angle of 60° as when measured horizontally. Quite recently some very careful experiments were made at Glasgow, and of three Gramme machines tested, the mean result was that an expenditure of 3·01 horse-power gave a light of 2,300 candle-power *measured horizontally*, or an average of 764·1 candles per horse-power. In a competitive trial of various machines in Switzerland, on the 20th January of this year (1881), the Gramme machine was beaten by the new Bürgin, which gave three lights of 1,360 candles each, *measured horizontally*, at an expenditure of 5 horse-power; this gives 816 candles per horse-power. Now if four pounds of coal per horse-power per hour be taken as the consumption by the steam engine it will probably be above the mark, as manufacturers now provide good engines that will run with less expenditure of coal than this. But taking four pounds per hour this would give a light of 304 candles for every pound of coal consumed. Now compare this with gas light: one ton of coal gives 10,000 cubic feet of gas: assuming as before that five cubic feet of gas will give a light equal to 15 candles, 68 feet of gas would be required for 204 candles, and this would necessitate the use of 15·23 pounds of coal; if half of this be supposed to be returned as coke and other products, there would still be a saving in the proportion of nearly 8 to 1 by using coal for generating light through the medium of electricity rather than by its direct conversion into gas. This calculation is simply intended to show the greater economy resulting from the transformation of coal energy into light by one means than by another, and does not of course represent actual money cost. Even by using gas itself as a motor, there is a marked economy compared with its use as light, which economy in a gas engine burning 26 cubic feet of gas per hour per horse-power would be in the

proportion of 5·3 to 1. But to come to actual figures: at the Albert Hall the actual cost per night for the electric lights was £1 10s. 6d., and 25,000 feet of gas were saved, the cost of which would have been £4 7s. 6d., so that here was a saving of 65 per cent. without counting interest on capital, which if reckoned would probably reduce the saving to 55 per cent. These figures are taken from Mr. A. Siemens's Paper read before the Society of Telegraph Engineers, last April. In this case, however, the lights were of great power—6,000 candles—and these large lights will always be more economical than smaller ones. At the British Museum—the details of which are also given in the Paper above referred to—the total cost for 360 hours, the total candle-power being 18,800, was £108 1s. 4d., or 6s. per hour, the same amount of gas at 2s. 6d. per 1,000 cubic feet would have cost 15s. 6d. per hour. At the Alexandra Palace, which was recently lit by four lights of 4,000 candle power, the following details of actual cost have been furnished me by the contractor, Mr. Crompton:—

Wages and incidental expenses per week of 48 hours	£2	4	0	Oil, waste, &c.	£0	5	0
Coal	0	14	10	Repairs	0	9	0
Carbons	1	4	8		£4	17	6

or 6·1 pence per light per hour. At the Queen Street Railway Station and Post Office, Glasgow, from data which I have received, the cost per light per hour averaged over one year should not exceed 7d., the lights here being also of 4,000 candles power. At Messrs. Siemens's works, where no charge is put down for motive power or attendance, the machines being driven by the general steam engine, two lights costing 3d. per hour have replaced 30 gaslights costing 6d. per hour. At the Stanton Iron Works, Yorkshire, where also the motive power is not charged, the cost comes out at 3·2 pence per hour per light. All the foregoing details of cost* refer to continuous current systems. The alternating systems are more expensive. The report of the Engineer to the Metropolitan Board of Works gave the cost of the first instalment of Jablochkoff lamps on the Embankment at 5·73 pence per light per hour, but now that the system has been extended and various improvements in the machinery, &c., made, the contract price according to M. Berly is to be 2½d. per light per hour. These lights, however, when naked have only 378·1 candle-power, so that allowing a very liberal margin for profit their cost must be considerably higher than the arc lights. The incandescent system has not been tried on a sufficiently large scale to enable any details of cost to be given, but the lamps can be made—either Mr. Swan's or Mr. Lane Fox's—for the small sum of 1s. each,† and at a lecture given by the former gentleman at Newcastle, in October last year, twenty lamps were fed by an electric current produced by a gas engine burning 160 cubic feet per hour; this would just give the cost per lamp per hour at one farthing, not using the most economical means of producing the electricity. A comparison of the figures here given tends to show that a brilliant arc light of 4,000 candle power can be produced for considerably less than 6d. per hour, and I believe electrical contractors generally well undertake to provide lights of this calibre for 7d. per light per hour. This price is considerably lower than would have been possible a year ago. The improvements made in every branch of electric lighting during last year were very great, and now that competition is coming keenly into play there is no doubt that the cost will diminish.

* Except in the case of the British Museum, where alternating current lights and continuous current lights were used conjointly.

† It must not be assumed that these lamps will be *sold* at this price.

Having thus shown the superiority of this mode of illumination over those at present in use, the practical question remains—Can we architects avail ourselves of it? In very many cases we can even now. Take the case of a country mansion standing in its own grounds. It is no uncommon thing to find such a mansion with a small gasworks attached to it for its own supply, and I have no hesitation in saying that a complete set of electric light apparatus, with steam engine of from 4 to 10 horse-power, could be set up and worked so much more economically than gas that the saving would soon pay for the outlay; all the offensive concomitants of gas manufacture would be avoided, and the safety of the premises from fire would be much greater. The same would apply to a factory, school, hospital or any large institution where accommodation could be provided for a steam engine; and even in towns for large establishments where gas is already laid on, I have shown that it would be more economical to use the gas to generate the electricity than to burn it. The case is at present rather different with private houses in a town. The difficulties to be overcome in this case are far greater than in the others, and ingenuity is now busily at work seeking to surmount them, but it can scarcely be said that they are surmounted yet. Mr. Lane-Fox, Mr. Swan and Mr. Edison, have each a different method of distribution, and each claims to have solved the problem. It would be beyond the scope of this Paper to describe their various methods, but speaking generally the plan is to have a number of generating centres for supplying the electric power, and to lead main and branch wires in all directions from these centres, which would occupy a very small space. Small switches something like gas-taps would turn on or shut off the electric current from the various houses supplied by it, and a measuring apparatus has been invented for recording the amount of electricity used. The number of lights on a circuit is no longer a source of difficulty; any one can be turned off without affecting the others, and there can be little doubt that the other obstacles which have prevented the substitution of electricity for gaslight on an extensive scale will vanish. No sensible man, however, will commit the absurdity of predicting—as suggested in a recent number of the Journal of Gas Lighting—that a day will come when the last gas-tap will be turned off for good. Such an invention as gas will never become useless, never unnecessary. The panic which recently seized gas shareholders had its parallel half a century ago when the oil merchants feared that the introduction of gas would ruin their business; and similar predictions were then made as to the impossibility of bringing gas to our houses as are now made with regard to the electric light. For the supply of heat and motive power, gas is, and will continue to be, invaluable, and numerous other means of employing it will doubtless be discovered, but for the production of an almost perfect light under certain conditions gas can never hope to rival its "brilliant compeer electricity." It must however be borne in mind that the science of electric lighting is still in its infancy. Although it is 80 years since science gave us this brilliant means of illumination, and 50 years since she supplemented that gift with another enabling us to do away with the old and cumbrous method of producing it, it is only within the last few years that any progress has been made in the industrial application of the discovery, but during that time the progress has been so rapid, and the improvements in every direction so great, that he would be a bold man who should predict the limit to its future possibilities.

Dr. JOHN HOPKINSON, F.R.S.—The lecturer has so fully and so ably dealt with the subject that he has left but little to be said by those who follow him. However, there are one

or two points on which I should like to make a few brief remarks. Mr. Slater referred to the experiments made at Glasgow. Those experiments were made under considerable disadvantage—at a public exhibition—and consequently they could not be made by any means so complete as experiments made in a private laboratory; but so far as they went I think they were accurate and reliable. The result arrived at was that with Mr. Crompton's lamps and the Gramme machine we obtained the light of over 2,000 candles measured horizontally—that is to say, measured in a direction in which the intensity was very much less than when measured in the direction in which it is generally used. That light of 2,000 candles was obtained with an expenditure of something like 4-horse power. Of the 4-horse power something less than half would be actually developed in the work itself, so we may say that from 1 horse power in an arc light we get horizontally something decidedly over 1000 candles. Mr. Slater has alluded to the difference in colour of different sources of light, and it would be apparent to all of us that with the brilliant arc light which was exhibited in the roof the gas light was of a very different kind and quality from the electric light. Mr. Slater has pointed out the reason of that, and I may perhaps enforce what he said by quoting an experiment first tried by Capt. Abbey, and later by myself and others. It is quite easy and strictly accurate to compare the quantity of red light in one source of light with the quantity in another, or the quantity of blue light in the first and of blue light in the second. If we make this comparison between the electric light and a candle we find that the proportion of the blue light of the electric light to the blue light of the candle is something like twice as great as the proportion of the red light of the electric light to the red light of the candle. Hence, so far as the effect upon the retina is concerned, the electric light is substantially the same in colour as sunlight. But it differs from sunlight in one respect. Owing to the absorption of the atmosphere, the invisible radiations of sunlight—*i.e.* those which have a shorter wave length than the radiations whereby we see—are fewer than of the electric light, and I think that some of the disagreeable physiological effects experienced after working closely for some time with the electric light are largely due to these radiations. By the use of the electric light important economies will be realized, not alone directly in the cheapness of the light, but by the absence of destructive effects. All who have been accustomed to gas must have noticed (where there are no special appliances in use) the rapidity with which it blackens our ceilings. This causes a serious addition to the cost of gas lighting which ought to be taken into account. But I do not think the time has yet come at which we can make fair comparisons between gas lighting and electric lighting. The cost in the case of the electric light depends very largely on the fixed expenses, what we allow for depreciation of the machinery and what for interest. In the comparisons made one is very seldom informed whether these charges are reckoned on a liberal scale. On the other hand, we learn that as electric lighting extends the working expenses will be greatly reduced, and also that other uses will be found for the electric current which will help to bear the dead expenses.

Mr. St. GEORGE LANE-FOX PITT.—It is with very considerable gratification that I have witnessed the way in which the electric light has been received here this evening. It is most encouraging to those who are working on the subject, because the enthusiasm displayed this evening betokens belief in it. But, in truth, it cannot be doubted that electricity and electric lighting have arrived at such a stage that no man can stop their progress. Still the

belief of people in authority is always of assistance to anything new, for it helps others to believe, and that is what we want at present. The subject is a new one, and very few people are acquainted with its details; but we hope very soon to know all about it, and then we shall go on very much faster than hitherto. We have to look to the future and see what electric lighting will do to supply domestic purposes. I believe within a short time all that has been said this evening with regard to the electric light will have been shown to be practical. Mr. Slater has had no time to show how electricity can be laid on to a district or a town to supply the general source of lighting for domestic purposes; but this is a question involving a good deal of discussion, and I will not trouble you further than to say that I believe it is perfectly possible to lay down mains in the street very much as you lay down gas mains, only with greater facility, for they would not occupy so much space and not require so much trouble in laying down and taking up. They could be laid down so as to radiate from single stations and single points, and thus supply an indefinitely large area. It is often objected that a gas or steam engine in a house would be very inconvenient, but I do not think that on the whole we shall ever be confronted with that difficulty. Another question that has been gone into slightly, and one which I know is specially interesting to those present this evening, is that of cost. It would be impossible in a short time to prove what I believe most emphatically, viz., that electricity will supersede gas in point of economy. It can be shown that energy can be applied more economically by means of electricity, and the larger the scale on which it is supplied the cheaper it will be. The reason why the incandescent lamps did not burn very successfully this evening probably is that the current was not regulated to a sufficient electromotive force. Every lamp requires a certain definite pressure in the electric mains to produce a given amount of light. The lamps here had too strong a current, and their life in consequence was shortened. But this is the sort of difficulty not in the least likely to occur in practice.

HORACE JONES, *Vice-President.*—It is with no small feelings of surprise and delight that I have seen the experiments far better conducted this evening than, I am sorry to say, they were conducted some eighteen months ago. With the earnest desire of getting the best light we could, a certain committee of the Corporation which I have the honour to advize, namely, the Markets Committee at Billingsgate, upon my advice, at my request, and by my very urgent endeavours, instituted at a very considerable expense several experiments on the Jablochkoff system; but eighteen months have made vast strides in this matter, and had we had the information then that we have now I think that the results would have been very different. We had some very considerable and very unpleasant matters to contend with. We had two Gramme machines, and one broke down and the other was maimed. There were other reasons, but it does clearly show, I think, to us all, that a little perseverance is necessary to obtain anything very excellent in a new matter. That gas will entirely go out I believe no more than that sperm oil has entirely gone out, but I dare say it will not be much more used in a few years, except in small private matters. There is one thing, Mr. President and gentlemen, I am sure you will see and think: that a more easy, flowing and brilliant discourse than that which we have had this evening it has not often fallen to our lot to hear. There is one thing I should like to ask, and that is, whether there may not be in some future time a possibility of obtaining electricity from batteries without steam or engine power. I have no doubt electricians know perfectly well where the difficulties are, and though we do not

expect them to tell us the whole of their secrets, yet if they will enlighten us a little we shall be very pleased to hear them.

Mr. R. E. B. CROMPTON.—I will help in one way by answering the gentleman who spoke last about the batteries. It would be going, indeed, a step backward to resort to batteries as a means of producing the electric current. When the light was produced in that way it was so expensive that it rendered useless all that long list of inventions relating to lamps read out by Mr. Slater. It was only when we turned to our good and faithful servant, steam, that we were able to produce the electric light with any degree of economy. It is true that batteries can be useful to us, but not quite in the original sense. The great philosopher's stone which we electric engineers are striving after is a reservoir of electric force—an electric accumulator. That accumulator we have to look for in some form of battery. One good form of secondary battery has been invented by M. Planté, and within the last few days I have heard that this has been improved upon by M. Faure, and that we are going to be very much astonished by his invention. In a box, not much larger than this table, will be stored a current sufficient to work that large lamp in the roof an hour and a half. This is a statement such as we can hardly believe. You have heard my name mentioned in connection with the lights, and I must only apologize for their behaviour. It is not easy to arrange lights, &c. for a temporary experiment like this. Even if we had had everything well arranged, the difficulty of making good the connections all over the roof is a great one. I have only been able to come and give this matter my personal attention for a few minutes this afternoon, and must therefore apologize for my lamps, which have burned far below their average steadiness. As to the question of the cost the figures read out by Mr. Slater *did* include the cost of plant. I have to cover not only wear and tear, and depreciation, but to make a fair commercial profit out of my contract. So far the light has only been produced on a small scale. Wait until we do it on the same extended scale as the gas companies, and then you will see how cheaply we shall produce the lights.

GEORGE E. STREET, R.A., F.S.A., *Past Vice-President.*—I should like to ask whether, in talking of these as steady lights, it is meant that they would be steady under proper conditions, for these are certainly very far from being steady. I cannot exaggerate the anxiety with which we architects are looking forward to the introduction of this light both for the preservation, the better lighting, and the cleanliness of our buildings, but the thing that stands in our way as much as anything is the fact that we are not able to secure a steady light. I am most anxious on this subject about the lighting of our large picture galleries. In those smaller lights which I have seen worked almost with perfect satisfaction one observes the flicker very much less—in fact, being more distributed, one does not notice it. That is the great difficulty which I hope electricians will manage to meet. We want a better regulator than you have at present devized. I feel quite certain that with so many clever men, hard at work on a thing which is in prospect, we shall have that steady light very soon, but if we do not all at once rush into your arms it is because in three months we expect it will be very much more perfect than it is now. I have no doubt it will be so at the rate you are going at. We are now waiting to light the New Courts of Justice, and holding the question in suspense till we can be quite certain that we have got a good light, but until the day you can give us a steady one architects will I think agree with me that we must

wait. Is not this very much owing to the fact that the whole of the arrangement is approaching perfection? I think Mr. Slater's Paper one of the most admirable addresses that I have ever heard in this room.

JOHN SLATER, B.A., *Associate.*—I do not think I need detain you very long in replying to the various remarks and inquiries that have been made by the speakers this evening. Mr. Street has asked me whether I consider the Joel light which has been burning for the greater part of this evening a steady light, and I am bound to say that, as we have seen it, it is not; but I have seen it burning much more steadily. No one can form any idea of the difficulty of conducting experiments * of this kind with temporary tackle and apparatus and without time for proper testing. I had fondly flattered myself that I had made every arrangement so that all the lamps could be tried on Saturday afternoon last. Instead of this, we did not get them all fixed till a quarter before eight o'clock this evening, and bearing that in mind I do not think the result so very bad. I very much regret that through not being able to regulate the current, I was unable to show you the Swan lamps for any length of time. If I could have kept those burning for ten minutes I think Mr. Street would have been convinced that electricity can be made to give a steady light. But even under all the difficulties that have beset us to-night—were these electric lights that have been burning so much less steady than gas lights under ordinary conditions? My experience is that gas lights often flicker, and they are certainly more affected by sudden draughts and gusts of wind than the electric lights. But, as I have more than once observed, it must not be forgotten that electric lighting is still in its infancy and improvements are being made rapidly in every branch of the subject. Take the case of these carbons. You hardly get two carbons in these arc lamps to burn equally well. There is something in the manufacture that makes some of them burn more steadily than others, and the reason of this is not yet properly known. I know that Mr. Norman Lockyer is making experiments by examining the spectrum of the light from the carbons at various stages of its intensity, and I have little doubt that the result of such experiments will be that before long we shall get a perfectly steady light. Of course architects at present are not prepared to put into their buildings unsightly lights; but I do not think I should have much hesitation in fitting up a house with the Swan or other similar lamps, if I could be allowed to choose my engine, see it set up, and test its working before the lamps were put in. As to batteries I quite agree with Mr. Crompton that it would be going back to revert to their use; but if a storehouse of electricity could be devized, that would be a grand thing.† In conclusion, I can only say that I feel greatly obliged for the way in which this Paper has been received.

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* The meeting-room was illuminated by one Crompton lamp, five Joel lamps and ten Swan lamps. The Joel lamps were worked by a small Siemens machine and the other by a Gramme, both machines being driven by a six horse-power Otto Silent Gas Engine, lent by Messrs. Crossley, Brothers.

† The secondary battery of M. Faure that has recently been invented seems to be precisely what is wanted.

VIII. PRESENTATION OF THE ROYAL GOLD MEDAL, 1881,

To George Godwin, F.R.S., F.S.A., *Past Vice-President.*

[Presented on Monday, 23rd May, 1881, George Edmund Street, R.A., *President,* in the Chair.]

THE PRESIDENT.—Gentlemen, it is now my duty to perform the act which every year serves to remind us, in the most practical manner possible, of the interest which the Queen deigns to take in the progress of our art. The distinction which Her Majesty bestows to-night, through my hands, has this peculiarity—characteristic of our national system—that we are first of all consulted as to the person to be honoured, and that Her Majesty, unless she see reason to the contrary, confirms and ratifies our selection. The recipient of the Medal which I am now commissioned to deliver, is therefore that one among us who, by the general vote of his brethren, is held to be the most worthy among those still undecorated. Jealous of the honour thus accorded, the Institute, with the Queen's sanction, has been in the habit of giving the Medal in successive years to an English architect or man of science, an English writer on architecture, and a foreign architect or writer. In this way the number of those who can at any one time hope to hold this distinction is small, and it follows that the award, if ever lightly made, or on insufficient or unworthy grounds, would be at once actively and jealously criticized; and we who have received it know that its value is thus greatly enhanced. On this occasion I think I may assume that it is because you, Mr. Godwin, have distinguished yourself, at least as much with your pen as with your pencil, that your name was preferred to that of any of your brethren. This year it is by custom the turn for the literary architect to be decorated, and that I do not think this a custom to be regretted, you will believe when I state that I received the Medal myself on the same mixed literary and artistic grounds.

The work of Mr. Godwin's life, as I need hardly tell anyone in this room, has been the editorship of the earliest and most important of the journals which devote themselves to architecture, its interest and progress. Of this, if I am rightly informed, he has been editor now for some thirty-seven years; and as he began his editorship within a year of the foundation of the journal, we can see how completely he is entitled to all the credit of its subsequent course. We all know that the *Builder* has been conducted with an honest anxiety to improve and popularize the public appreciation of architecture; and I believe I express the simple truth when I say that, in avoiding the pitfall of making it merely a professional organ, Mr. Godwin has conferred a distinct benefit upon us. It would have been a real calamity if, for all these years, it had been our own professional advantage and our own concerns, as distinguished from those of the public, which had been the main object of the editor of such a paper. With a much larger sense of what was really for the good of our art, Mr. Godwin has made his journal one which, whilst it is always ready to devote itself with zeal to architectural questions, never does so to the prejudice of, or in forgetfulness of, those without whom we should not exist, those who do us the honour to put work into our hands.

Among the works for which Mr. Godwin is specially known are those which he has from time to time published on the subject of the crying evils of bad drainage, bad ventilation and

bad building, especially as these affect the condition and happiness of the labouring classes No more worthy work can be done; and though much—very much—still remains to be done before we can be otherwise than ashamed of our condition in this respect, to Mr. Godwin, as one of the pioneers of progress in such really vital work, no small honour is due. Then, to turn to another branch of his work, I believe that I am not wrong in attributing at least the Lion's share of the work done by the Art Union of London to Mr. Godwin. For many years he acted as one of the Honorary Secretaries, and it was mainly, no doubt, to his energy and powers of organization that the large and lasting success of the Institution has been due. I need not go through the catalogue of publications which we owe to Mr. Godwin, from *The Churches of London*, published in 1838, to his *Plea for the Establishment of a National Theatre*, published in 1878, covering a period of forty years. They deal with a variety of subjects full of interest to most of us. No contrast between new ways and old is greater than that which now leads the architect to become a literary man as well as an artist. In the older days this was never known. But the invention of printing led naturally to such a change, and the man deserves well of us who has made, as Mr. Godwin has, good use of the opportunities which it affords for the wide dissemination of information and for the criticism and illustration of architecture. Unfortunately success in one branch of such an architect's work is likely, as a rule, to lead to the execution of less building work than would otherwise have been accomplished, and with all his energy a successful author is likely to suffer somewhat in his practice as an architect. I am unable, therefore, to give you a long list of buildings erected by Mr. Godwin; but his hands have not been unoccupied, and among others St. Mary's Church, West Brompton, and the restoration of the fine Church of St. Mary-Redcliffe, Bristol, may be taken, I think, as typical examples.

And now, Mr. Godwin, without further dwelling upon details which were familiar to the Members before they resolved to submit your name to Her Majesty for the bestowal of this Medal, I will only say that, though it was first instituted in 1848, it falls on me to give you a decoration which you share with but a small band of living men. Death has been busy in our ranks, and at the present moment you make the ninth Englishman who holds this Royal Gold Medal. I congratulate you on the honour that the Queen, advised by your brethren, has done you, and I trust you may long be able to continue your labours on behalf of the art and the profession, to which all here are equally with yourself, I hope, devoted.

GEORGE GODWIN, F.R.S., F.S.A., *Past Vice-President.*—Mr. President, Gentlemen and Colleagues, it is unnecessary for me to tell you that I appreciate very highly the honour which has been conferred upon me—an honour that comes directly from Her Majesty the Queen, at the intercession of the Royal Institute of British Architects. I am particularly indebted to you, Sir, for the genial and flattering manner in which you have been pleased to speak of my doings, and to you, Gentlemen, I can scarcely express my thanks for the kind and cordial way in which you have received this announcement. It was my good fortune in student days to receive from the hands of a distinguished predecessor of yours in that chair, the Earl de Grey—whose portrait hangs in this room—the first medal ever given by the Institute, for an essay which was received with more favour, and had more influence on building construction, than I could have ventured to hope for. I can see your predecessor,

Sir, as plainly now as I can see you, and I can hear his words as plainly as I heard yours; and I remember vividly the flush of pleasure experienced some days after on reading a few lines of hearty encouragement in the *Literary Gazette* of that day, written by genial William Jerdan. I see with delight one at least who was present on that occasion, my much-esteemed and affectionate friend Professor Donaldson, who, from that time to this, has honoured and favoured me with his regard. Of the 131 persons who, including Honorary Members and Associates, then formed the Institute (which now numbers, after the elections of this evening, as nearly as possible 1,050), only half a dozen more remain. Most of them made their mark and handed on the torch to worthy successors. Well, Sir, between these two presentations lies my whole working life, and if it has not been a particularly brilliant one, I may venture to assert, without fear of contradiction, that it has been one of earnest and continuous endeavour to spread information, to sustain the dignity of the profession, and to contribute to the welfare and elevation of all classes. I am particularly pleased that the President should have laid emphasis on my connexion with the *Builder*, and it was very agreeable to me to find him giving his approval to that policy which led me to make its scope so large as to obtain many besides professional readers, and which, I venture to think, has given to architects and architecture a much larger and more appreciative audience, throughout the kingdom and colonies, than they otherwise would have had. Mistakes have doubtless been made at times, and individuals may have felt aggrieved, but if they will kindly remember how many opportunities to err the editor of such a paper has every week, and that these bundles of opportunities have occurred to me more than 1,900 times, I think I may look for their forgiveness. This, at any rate, I will claim, that I have never gone out of my way to give pain or cause annoyance. I am detaining you, I fear, egotistically, but I cannot refrain from a brief observation on the allusion made to the part I have taken in setting forth the miserable conditions which prevailed and prevail in the homes of London and our large towns, and in endeavouring to arouse all classes to the perception of the necessity for sanitary improvements. The investigation of these matters was conducted by me for some years at considerable personal sacrifice, and at some personal risk, and if I claim to have been one of the earliest and most persistent workers in this field, and venture to suppose that some part of the wide-spread feeling which now prevails on the subject is due to those efforts of mine, I do so in order that I may assert that the profession of architects had its representative, in the very earliest stage of this vitally important movement. I must ask you to bear with me for a few minutes, because I have something to say in which I feel much interested, and because I wish to show my appreciation of the consideration I have received by something more than words. We have all been taught that architecture concerns itself with commodity, fitness and delight —commodity and fitness as well as delight—and it seems very desirable this lesson should be always remembered. I have a very strong conviction that, unless the architects of the future are prepared to see the construction of many buildings pass into the hands of another set of men, they must make themselves conversant with the requirements and facilities of modern times, the newest and most improved modes of construction, and the best arrangements to insure healthful and happy life. To keep this fact before the rising generation of architects, and provide an inducement to follow such a course, I am willing, if the sanction of the Council be obtained, and the idea find favour at your hands, to Found—not a scholarship or a medal,

but, by the investment of, say £1,000.—a Purse of £35. or £40. a year, the recipient of which would be required, during a month's or six weeks' residence abroad, to examine, study, and report on some of the best specimens of modern planning, modern modes of construction, drainage, water-supply, ventilation, and other sanitary arrangements, to be found in the city or town he elected to visit. I should propose to adopt an old word and call it a *Bursary*. The mode of competing for it would have to be settled hereafter, but I see no difficulty about that; the Council will doubtless appoint a small committee to confer with me, and, together, we shall be able to arrange a satisfactory scheme. It might be, I think, in some way connected with the Institute Medal at present given for an essay, and I am so anxious to see results—results which, I venture to believe, will, unless I am greatly mistaken, in due course of time prove to be of the greatest value—that I should be disposed, if the recipient of that medal for the present year be found a capable person, and willing to accept the obligations imposed upon him, to provide the Bursary of this year in addition to the investment, so that we might at once begin to receive this information. The difficulty of getting information from abroad is very considerable, and I have often heard our present energetic and excellent Secretary complain of the impossibility of inducing foreign Members, even after promising him, to send any particulars of their work; so that even in that respect I think considerable advantage would follow from this proposition I am making. The notes made would, of course, remain the property of the recipient of the Bursary, who would, perhaps, be expected to provide a Paper embodying them, to be read before the Institute during the session; but he would be able to publish them, and, I think, as time went on, we should have a series of reports which would be of the greatest value to architects and architecture in England. I beg you not to consider that I am throwing any slight, or anything like cold water, upon the practice of sketching and measuring old buildings, such as is now pursued by the travelling students of the Institute and of the Royal Academy. Far from it. The pursuit and study of beauty must still be one of the main points with an architect if he is to be justified in taking the title of artist. I simply wish it to be remembered that there is something more to be borne in mind—that architecture is a science as well as an art, and that the architect of the future must not simply be the apostle of the past, but the good genius of to-day. I am not prepared to say—"Let the dead past bury its dead." Not by any means. The past is too valuable for us to ignore it, and we must lay ourselves open to accept its wonderful lessons. But I would very earnestly take up the next line of the poet, and say,—"Act, act in the living present." I will not detain you any longer. I trust you will consider that this proposition of mine, if adopted, is likely to be of service, not alone to architects, but to the public at large.

*** See, for the resolution accepting Mr. Godwin's munificent offer, the PROCEEDINGS, 1880-81, page 255. The speeches in reference thereto, delivered by the President and two Past-Presidents, are reported on the same page.

GENERAL CONFERENCE OF ARCHITECTS, 1881.

OPENING ADDRESS. By John Whichcord, F.S.A., *President.*

[Read at the First Meeting of the Conference, on Friday Evening, 6th May, 1881.]

GENTLEMEN.—It is now three years since a general invitation was given to the architects of the United Kingdom to meet in these rooms for the purpose of discussing questions connected with the art, science and business of our profession; and ten years have elapsed since the first General Conference of British Architects was convened under the Presidentship of the late Thomas Henry Wyatt, my most esteemed predecessor and for a time the Honorary Secretary of the Institute. He at that first Conference, when doubts were expressed as to the expediency of making such conferences annual or biennial, hinted that he thought they should be made triennial; and the Council recently determined to allow three years to elapse since the last Conference of 1878, before inviting gentlemen to another. They also decided that another three years should pass before another invitation of a similar kind should be issued; and they were actuated, I think, by the remembrance that three years hence our jubilee would be attained, for in 1884 the Institute of British Architects will have been founded fifty years.

The programme* we have to offer is perhaps neither new nor attractive. Indeed it is pretty much the same, though in a more concentrated form, as that presented ten years ago, when Mr. John Hebb read an excellent paper on "Taking out Quantities and Measuring Works," and Professor Kerr treated with equal force on "The Commercial Aspect of Architectural Competitions," both subjects which still exercise the minds of many earnest and thorough workers in the cause of unity and intelligent reform. They are subjects which, during ten years, have received a great deal of elucidation, not only from professional inquirers but from independent critics, subjects also which are better understood by ourselves and the public than was the case ten years ago. I am not however going to treat at length of either subject in this Address. I simply repeat what I said in 1879 from this chair, that "there is one detail of architectural practice—often forced upon professional men who happen to be situated at a distance from the large provincial capitals—which offers to the outsider an easy handle of criticism. It lies in the mode of payment adopted for bills of Quantities." I commend this fact to your notice, more especially because the Council of the Institute have lately passed a resolution in reference to the alleged practice of a few architects and Quantity-surveyors —a practice whereby an architect, without doing a stroke of the work or accepting one iota of the responsibility, receives a share of the commission paid to the Quantity-surveyor, who, in the interest of their common employer, takes out the Quantities. The course pursued by the Institute in this matter, both on the part of the various committees who have been occupied with the details of the subject and on that of the Council, will be fully explained to you in the Address which Mr. Arthur Cates, as Chairman of the Meeting convened for tomorrow morning, will

* The programme of this Conference is given in the Proceedings, 1880-81, page 236; and the entire Address at page 242 of the same volume—the details of Visits to new buildings, to Buckingham Palace, &c., with other particulars for the guidance of Members, being here necessarily omitted.

deliver. On the question of competitions much has recently been said, and the Memorial presented by Mr. Street from more than 1300 architects to the Council, praying that steps should be taken to place the competition system upon a more satisfactory basis, by means of united action on the part of the profession of architects, is fresh in your minds. Some of you may also be aware that, in the "Conditions" drawn up by the Council, in response to an invitation given by the Lord Provost of Glasgow, the leading suggestion of that Memorial was not overlooked. Our difficulty, however, does not lie in recommending equitable conditions; the point is how to get such equitable conditions adopted, and then equitably carried out, and further, how, when the conditions of a competition are not equitable, you are to restrain colleagues, especially the younger men, from ignoring their own interests no less than those of the profession to which they belong. Whatever may ultimately be resolved upon in this competition question—after the Institute Committee on Competitions have finally reported and the Council have discussed the report—whatever professional combination may be formed, I trust that the bad aspect of modern unionism may be kept steadily in view, so that we may always know what to avoid. At the same time I admit that some sort of agreement must necessarily be made and adhered to,—such agreement to form a basis for the conduct of those whose interests induce them to take part in this now recognized and systematic lottery.

Perhaps it will assist the discussion of this subject, and save some heartburning and loss of hard cash, if I give you the outlines of a scheme of architectural competition which, within the last week or so, has been devized in order to obtain a variety of designs for a building proposed to be erected in London at an outlay of, possibly, a quarter of a million sterling. In order that you may understand the position, I must tell you that the proposed building is to be erected upon a site already covered with the foundation and basement walls of a huge structure, the construction of which was stopped a few years ago for want of funds. The site, together with the partially executed buildings upon it, have been acquired by a group of well-known and experienced speculators, who, with or without professional assistance, have drawn up the conditions of a limited architectural competition, such as, I think, are unparaleled in the annals of Architectural Competition. First, they send a lithographed plan of the site showing the foundations existing upon it, and though they believe the measurements of the walls, &c., on the site are strictly accurate, the competitor is advised to carefully survey it, for these foundations are to be utilized. As to the general character of the building to be designed, the competitor is left free to carry out his own ideas, provided above all things that the internal arrangements conform to those of the best similar buildings in this country, or on the Continent, or in the United States. The plans, sections and elevations are to be drawn to a uniform scale of $\frac{1}{8}$th of an inch to a foot (unless $\frac{1}{12}$th of an inch be preferred by the competitor) with the leading dimensions figured. There are to be elevations of the principal fronts, longitudinal and transverse sections, with a plan of each floor. The architects invited to prepare the designs are some half-dozen men of experience and position, myself being one of the number, and this is how we are to be remunerated. A sum of £150 will be paid to each competitor "towards the out-of-pocket expenses," and "the designs and plans will become the property of the proprietors who are not to be bound to adopt any of them." Now, Gentlemen, when I was honoured with

an invitation to join in this competition—it being nearly twenty years since I have been a competitor in an architectural competition—I wrote for further information, and in terms of which the following is an extract:—

"1. I presume that the six or seven architects selected to compete are all Fellows of the Royal Institute of British Architects, or at all events of admitted position in the profession. I think the names should be disclosed, that each may form his own judgment on this point.

"2. The sum offered to each competitor towards the cost of his drawings is a satisfactory feature, but it is palpable that the only real prize to an architect of standing would be the ultimate employment to carry out the work, which is one of great magnitude and cost. For this reason the proprietors should bind themselves to employ the architect whose plans are selected upon the usual terms of professional remuneration.

"3. A professional assessor should be appointed by the proprietors, and his award as to the merits of the several designs should be final. It is hardly probable that the proprietors themselves are qualified to interpret the refinement of architectural design, or to deal with the reputation of six or seven leading architects. At all events I think that the competitors should be informed who will be their judges.

"4. I do not find in the instructions any allusion to the outlay contemplated upon the building, nor any limit as to height and number of rooms. I presume these are points purposely omitted."

The answers I obtained to the foregoing questions were not satisfactory; indeed they were ludicrously the reverse. I was informed that the proprietors would exercise their own judgment in the selection, that they would be influenced in that judgment, "in favour of a plain building giving the largest number of lettable rooms," and that it was "the object of the proprietors to have a building which would secure the best commercial results." Observe, Gentlemen, this is not an instance in which an attempt is made to evoke the latent genius of some heaven-born architect, to call up from obscurity some patient, unknown and struggling artist, who shall produce a monument that may hereafter be regarded as a certain mark in the varying records of architectural history. This is a plain business transaction, proposed by men of an eminently business character, to six or seven members of a profession supposed to be willing at all times to sacrifice its time, its talent, its hard-earned money, if not its good name, in a blind race for a small bag of sovereigns. The six sets of plans for a building which will cost at least £250,000. will be acquired by the proprietors for the sum of £900., and from these six sets, the work of architects of standing and experience, some clever schemer of plans will be enabled to produce a final design, possessing the highest commercial advantages which, probably, a contractor may be employed to carry out without any further professional assistance—at all events no assurance has been given that it will not be so. If there be anyone present who has responded to the invitation to compete, on such terms as I have described, for such a building as the one I allude to, I trust that he will refuse to assist in bringing discredit upon his calling as an artist and a man of science. I need hardly add that, after eliciting the information I have communicated, and making a final attempt to get the conditions altered for the good of my colleagues, I declined to join in the competition.

You will also, at the sixth and final Meeting of this Conference, have an opportunity to hear and discuss the opinions of two gentlemen practically occupied in the art of mural decoration, a subject which in 1878, at the last Conference, was ably treated by Mr. Armitage, the well-known Royal Academician and professor of painting. The subject is one of such importance to architects that I cannot but urge upon those of our Honorary Associates whose inclinations and occupations are directed to its study and practice, to give us the benefit, if

not of their opinions, at least of their presence at the discussion. I could have wished that William Burges had been alive to join in it, or that our rooms might have been adorned on the occasion with his beautiful designs for mural decoration. The thought displayed in every scheme of wall-covering invented or adapted by Burges has always seemed to me to place him high in the ranks of those architects whose practice is concerned with this interesting branch of architecture.

There is one subject of discussion which, at the first Conference of ten years ago, occupied a prominent place in the programme—a subject which has since that time been frequently discussed within these walls—but which does not appear in the agenda of business prepared for your present consideration. I refer to the subject of obligatory Examination for membership. That, as far as we are concerned, is now settled, and such being the case, perhaps I may be permitted to recapitulate one or two facts connected with the discussion of this important matter during the course of my presidentship, more especially because I know that there are present at this moment gentlemen connected with the provincial architectural societies, whose action for or against may exercise an important influence upon the future of the Chartered Body of British Architects. In my first Presidential Address I treated at some length of the possibility and desirability of preparing for the execution of that by-law (passed in 1877) whereby "all gentlemen engaged in the study or practice of civil architecture, before presenting themselves for election as Associates, shall after May, 1882, be required to pass an examination before their election, according to a standard to be fixed from time to time by the Council." Well, we have fixed the standard for 1882, and in March next the first obligatory Examination for membership will take place under the superintendence of a Board of Examiners composed of the President, Vice-Presidents, the Honorary Secretary, and seven Fellows. The regulations and programme containing the slight amendments passed at the Business Meeting summoned to discuss them, are now printed, together with extracts from the Charter and By-laws, the forms of Declaration and Nomination, and the new rules for the award of the Ashpitel Prize, so that in this publication, copies of which are on the table, may be found full particulars of the course to be pursued by students and others for admission to the Institute as Associates. It is proposed to send a copy to every Member of the Institute, and should the authorities of architectural societies in different parts of the United Kingdom express a wish to receive a certain number of copies they shall be sent. Our object is to direct the attention of professional men, both Members and non-members, to the kind of test we propose to apply to young men desirous of earning the honour as well as the advantage of the Associateship. And pray observe, Gentlemen, I am using no mere form of words. At the present moment every Member of the Institute who has received a certificate of proficiency in the Voluntary Examination is distinguished in our published roll by a special mark; and hereafter every Associate who enters by examination will be similarly distinguished. A time will come no doubt when such a mode of distinction may be unnecessary, when most of those who joined under the original rules will sleep the sleep of the just, and the great mass of Members will have entered by examination.

But for the remainder of this century I may fairly predict that new Associates by examination will be distinguished, in the roll of members, from their older colleagues. This is

what I want gentlemen, who have come here to night from the great provincial centres, to tell their pupils. I should like to be assured that, under the fostering advice and direction of architectural societies, students were preparing for the course laid down in this publication to which I allude; to know that in Glasgow, Manchester, Liverpool, Leeds, Leicester, Newcastle, Birmingham, Sheffield, Edinburgh, there are groups of young men who look to the Royal Institute to confirm by examination the training they have received under the guidance of their local societies. But I fancy that some of you are saying of this obligatory Examination, "Oh! it is only half an examination, only intended for Associates, and if young men will wait a few years they will be able to enter, full-fledged, as Fellows." It is therefore but justice to those who think so that I should disabuse their minds of an undoubted error. You may have observed that lately a very large accession of new Members has taken place, and at present about a hundred others are waiting to be admitted as Associates. But comparatively few gentlemen are recommended by the Council for admission as Fellows. The applications, however, are numerous, and if the Council did not oppose every reasonable obstacle to candidates, a large number of new Fellows would be admitted, and would have been admitted during the last year. My opinion is that, before the close of 1882, the Council will recommend to the Institute an addition to the by-law referring to the obligatory Examination of candidates for Associateship. They will recommend that no gentleman shall be admitted a Fellow until he has passed a certain number of years in the ranks of the Associates—at least, that is my conviction. Meanwhile, Gentlemen, enough has been done and is being done to prove the earnestness of our endeavours, within the Institute, to advance the interests, not of the corporate body alone, but of the whole profession throughout the world.

GEORGE EDMUND STREET, R.A., *Past Vice-President*, ventured to make complaint of only one thing in regard to the Address and that was its brevity. That, however, if it were a fault in one sense, was an example which might be usefully put forward, and no doubt all who took part in the discussions would endeavour to emulate that good example. There were four principal subjects which the President had brought before the Conference. As to the subject of Quantities, he trusted, on behalf of those architects who never had anything to do with their preparation, that the deliberations of the Conference would lead the way to some more regular and systematic mode of preparing Quantities for buildings, together with a more definite mode of payment for such work. He did not know what the experience of other architects might be, but his experience was that sometimes, when the Quantities of a building had been taken out, they were found to be either very full or very loose, and there was also a heavy charge for lithography. He hoped the Conference would be able to arrive at some improvement in the present mode of conducting such business. On the much more barren subject of Architectural Competitions, he wished to say a few words, because so many architects had done him the honour to consult him on the subject some months ago, when that astoundingly large Memorial on Competitions was presented to the Council. It seemed to him that, in much of the discussion that had taken place since the Memorial was presented, some points had been overlooked. It was, he thought, extremely desirable that whatever rules might be framed by the Conference or by the Institute, they should be as moderate as possible. If they attempted to go too much into detail, such rules would not be accepted by the public,

nor, he thought, by a great many architects. What was desirable was the formulation of some short, definite rules for the acceptance of the profession and of the public too. If too much were attempted by the Conference, nothing would be done. If the conditions were made too complicated, the public would refuse to accept them, and possibly many architects would feel themselves debarred from becoming Members of the Institute. He thought that any rules which would prevent the younger members of the profession from entering into competitions under certain conditions would be wrong and impolitic, for in competitions lay the only hope of many men, who entered the profession without influential connexions, of making themselves known. He was rather inclined to think that, in spite of the exceptionally bad case which the President had quoted—certainly one of the most monstrous proposals he had ever heard of in connexion with competitions—competitions were not so rife now as they were a few years ago. The system was, he thought, killing itself. In view of the promised Paper by Mr. Ford Madox Brown on mural painting, he wished to call attention to the steps about to be taken by the Royal Academy to promote the study and practice of mural decoration, and to state that he had promised the Academy that, from time to time, architects would find suitable spaces in their buildings for the exercise of the powers of the students to whom prizes for mural painting would be offered every year. He thought that what the Academy proposed to do, in this matter, was the most practical proposal that had yet been made to force —he might almost say—mural decoration upon a world which, singular enough, did not seem to appreciate it as it should. With regard to the subject of architectural examination or education—for one seemed to him to be necessarily mixed up with the other—he thought there could be no doubt that any system of architectural examination involved, as a matter of course, more careful architectural education. But his principal objection to the scheme which had been prepared was that it hardly went far enough, although he understood and took it for granted, that the scheme as now presented was a very mild one, because it was the first attempt to enforce it, and that by degrees it would be made more strict in its terms. His decided conviction was, that what was wanted was an examination which could be passed only by accomplished men. With regard to this question of architectural education, he ventured to refer to the work which the Royal Academy was doing in that direction. The Royal Academy had 400 students in its schools, and last year the rather astonishing fact occurred that the number of admissions of architects was equal to the number of admissions of painters, the number being precisely the same of each class of students, namely, 128. The architectural students were under the guidance of a very able master, and they were visited once in every week by one of the architectural Members of the Academy. Three of the architectural Members, for instance, each took thirteen weeks' visiting and teaching. In order to encourage architectural students, the Academy was holding out increased inducements. For instance, the Academy Travelling Studentship, in the Gold Medal year, would be worth £200., and in alternate years the Academy intended to give a sum of money to enable a young architect to travel in England. It was establishing a modelling class for young architects; it compelled them to listen to lectures; and, in short, it was doing everything it could to fit young architects to pass the Examination of the Institute.

HORACE JONES, *Vice-President*, said that upon one point he differed from his friend, Mr. Street, diametrically, and he would illustrate it by a story. When the god Vishnu first

got command of heaven, he called up Brahma and consulted him as to the multitudes on earth coming to heaven. Brahma said that if they opened the door just a little bit, only the big and clever would get in; but if they opened it wide they would get them all coming up gradually, and when this was the case, then they could shut the gate. So, let them, only from time to time, shut the gates of the Institute, and only now and then refuse admission, except to those who were properly qualified.

Conference Second Meeting.

BILLS OF QUANTITIES.

[Saturday Morning, 7th May, 1881, Arthur Cates, *Member of Council,* in the Chair.]

THE CHAIRMAN.—Gentlemen, at the concluding meeting of the Third Conference of Architects, held in 1874, a resolution was adopted requesting the Council of the Institute to bring the subject of "The Employment of Surveyors" before a future Conference, and in accordance with that request, two mornings of this Conference have been appropriated to the subject, under the more general head of "Quantities." The consideration of the subject which has thus been allocated for discussion at these two meetings will probably be assisted if, in opening the proceedings, I occupy a few minutes with a summary of what has been done in relation to the subject since the question was first mooted in these rooms.

In his Opening Address at the First General Conference of Architects, on May 22, 1871, the then President of the Institute, the late Mr. T. H. Wyatt, entered at some length upon the practice of architects in relation to Quantities, and expressed his own views as follows:—

"I believe that the simplest and most satisfactory arrangement would be to disconnect the surveyor from the builder, to make him (on the nomination of the architect) the agent and adviser of the employer in the matter of Quantities, as the architect is in matters of arrangement, taste, construction and decoration. That he should take out the Quantities from the architect's drawings on his own responsibility; that he should be paid by the employer instead of by the builder (half on the completion of his Quantities, and half on completion of the work and settlement of account). That the priced bills of Quantities should be attached to, and form part of, the contract, as much as the drawings and specifications; and when signed and sealed up, should not be referred to again till necessary for making up the accounts, except with the consent of *both parties.* That the builder should not be held responsible for the execution of any works not included in these Quantities, and for which naturally, as they have not been included in his priced bills of Quantities, he has not been paid; but that, on the other hand, he must be held responsible to execute (or to have deducted from his bill, in making up the final account) any portion of the work included in the Quantities which he has not executed. We should thus, I think, have a fair guarantee that only the actual quantity of work shown on the drawings was included in the Quantities, and thus the cost of our works would not be unnecessarily swelled. The employer would be fully protected, for as long as his architect and his surveyor were honest men, he would only pay for work actually executed, and there would be no margin taken to cover unknown contingencies. I have adopted this system in my own practice, and can scarcely imagine, though I should be ready to hear, any practical objection that can be urged against it. I can conceive nothing more unjust than to require a builder to take the Quantities as they come from your surveyor, denying him the right to appoint a surveyor to verify on his part the accuracy of those Quantities, and yet to bind him in a contract to execute all the works shown on a certain set of drawings, and described in a given specification, though many of the items may have been omitted in the Quantities you force him to take without guaranteeing their accuracy. I hear this is sometimes sought to be done."

The interest which the introduction of a then novel subject into the Presidential Address aroused was strikingly evidenced by the animated discussion which followed, and which was almost exclusively devoted to this question. Next day a Paper was read by Mr. John Hebb, "On Taking-out Quantities and Measuring Works," in the course of which he asked, "Why should not an architect take out his own Quantities?" As a consequence of the interest thus manifested, at the adjourned meeting held May 26, 1871, the Council were requested to appoint a committee on "The Employment of Surveyors." This committee circulated widely in the profession the following questions, namely:—

a. Is it desirable that the practice generally adopted in the case of large works (whereby a surveyor is appointed to represent the employer, and another the builders, such surveyors being jointly responsible to the builder for the accuracy of the Quantities), should be in any way modified?

b. It was suggested as a convenient course for general adoption that the Quantities should be prepared by a surveyor nominated by the architect, and who would be responsible to the employer for his accuracy, the builder being relieved from any responsibility in regard thereto.

c. The adoption of this course will go far towards disconnecting the surveyor from the builder, and making him the agent and adviser of the employer in the matter of Quantities, &c. Would this be a system advantageous and desirable for general adoption?

d. A suggestion that the Bills of Quantities should form part of the contract was well received. Architects in leading practice mentioned that they had for many years adopted such a course, and found it to work well, and to be equitable to both employer and builder. Are there any valid objections to the introduction of such a system, the dimensions on which the bills are founded being, in such a case placed in the hands of both architect and builder?

e. It appears to be not unusual for some architects, especially in the provinces, to furnish the Bills of Quantities for works to be carried out under their own superintendence. However convenient this practice may be in some instances, are not special precautions necessary? Should not the "Bills" in such instances invariably form part of the contract? And from whom should the architect receive payment for such Quantities?

f. It was mentioned, as being an ordinary and reasonable course, that the responsibility of the accuracy of the Quantities should be thrown upon the builder, by fixing a time, say one month from the acceptance of the tender, during which he might prove the Quantities, but after which no objection would be allowed. Might not great injustice be committed under such a system?

g. It would be desirable to secure more general uniformity of practice with regard to the taking-out of quantities. How can this be best attained?

To these questions a large number of replies were received, evincing a wide diversity of opinion, in some cases, however, to be explained by individual and local circumstances. A few extracts from these replies may be interesting, and I will read a dozen, characteristic of the diverse views expressed, all selected from the replies of men of good position:—

1. "I think it objectionable that the architect should have anything to do with the Quantities. It places him in a position of suspicion from both sides, and it places too much power in his hands."
2. "The suggestion that the Bills of Quantities should form a part of the contract, is, I think, highly objectionable. It would, in fact, be a direct premium to carelessness, &c. If the architect supplies the Quantities he should be responsible for their accuracy. . . . The surveyor being paid for taking the Quantities, should be held responsible . . . . The idea of throwing the responsibility of the test of accuracy on the builder is an unjust one."
3. "The Bills of Quantities cannot form 'part of the contract.' They will necessarily become the whole substance of the contract, drawings and specifications being merely explanatory of the mode in which the work is to be done. This system is open to the fatal objection that it would leave the proprietor unprotected against all errors or omissions, which protection it was the object of the Quantities to provide for him."
4. "The architect and the builder should keep at arm's length, and the employer should know of every

arrangement between them. Quantities ought not to be charged for, which the builder has to verify or retake."

5. "I consider it most objectionable for any architect to furnish Quantities."
6. "I always make the Quantities part and parcel of the contract, and I have always found such a plan most advantageous for the employer. I always let my surveyor make a copy of the dimensions, and give them to the builder. I think it a great mistake for architects to take out their own Quantities; if they do, they should be part of the contract, and be paid for by the employer."
7. "The employment of the architect to take out the Quantities should have the *full* sanction, specifically given, of the employer. The Bills should be attached to the contract. The architect should receive payment *direct* from the employer, in the same way as he does his commission as architect."
8. "It seems to me that when an architect advises the employment of an independent surveyor, as the agent of the employer, he should have no pecuniary interest whatever in the Quantities."
9. "I think every possible objection should be taken to architects taking out their own Quantities: it leads to endless disputes, nearly always to the discredit of the profession, and quite neutralizes all efforts to render the members of it more of artists or less of surveyors."
10. "The employment of a Quantity-surveyor other than the architect is very advantageous to the designer of the plans, because omissions in specifications, neglected details in plans, are suggested by him, and hence greater completeness is obtained."
11. "I consider it the proper course that the architect should take out the Quantities from his own plans. He, of all men, should know the anatomy and construction of the plans. Of course he is liable to error, but he should take great care and precautions to avoid it."
12. "I am of opinion that it is best for the architect to furnish Bills of Quantities, with a heading similar to that subjoined,* and to protect himself by taking a memorandum from the builder like that marked† I have no objection to other architects adopting whatever plan they like, but I protest against the Institute laying down any rule casting any stigma or reflection on those 'who take out their own Quantities.' Some architects are 'mere artists,' and cannot take them out; some are too lazy, and 'wo'n't;' some too nervous, and 'daren't.' I hold that the truest architect is he who can and does do everything, from the design to the Bill of Quantities."

After considering the lengthy and conflicting replies received, the committee agreed to the following report:—

Resolution of the Conference of 1871.—"That with reference to the appointment of surveyors to take out quantities (a custom on which evidently a good deal of difference of opinion exists) the Council of the Institute be requested to appoint a Committee of five or more members, and that, with a view to assist the Institute Secretary in obtaining provincial opinion on this matter, and as representing the views of the surveyors, the names of Mr. Arthur Cates and Mr. T. M. Rickman be added to this Committee; and that the report of this Committee be dealt with in the same manner as has been suggested in the two former cases."

In accordance with the above resolution the special Committee subsequently appointed by the Council to consider the subject of the employment of surveyors beg to report as follows:—

The wide range of the subject, and the varied opinions which had been expressed at the Conference, rendered it difficult for the Committee to determine how best to proceed; after having collected a certain amount of information they prepared a series of inquiries which were circulated in the profession throughout the country, and to which sixty replies were received; these replies evince a wide diversity of opinion, arising from local circumstances and individual varieties of practice, and have satisfied your Committee that for the present it will not be practicable to lay down any fixed rule for the guidance of the architect in dealing with

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* "The contractor whose tender is accepted will be at liberty to compare the following Bill of Quantities with the drawing and specification before he signs the contract, and any errors then pointed out will be corrected. After accepting the Bill of Quantities as correct, no notice can be taken of any error that may subsequently be discovered. The contractor is to pay the architect two per cent., on the amount of the complete tender, for the Bill of Quantities, and ——— for printing, when he signs the contract."

† "I hereby certify that I have examined the Bills of Quantities supplied by Mr. ———, for the ——— and find them correct; and I hereby agree to accept them as correct, and to take all responsibility as to their accuracy or inaccuracy upon myself in consideration of the advantage which they have afforded me."

"quantities." Each case must be governed by local or personal considerations, and the Committee have therefore deemed it expedient to make their recommendations and expressions of opinion so general as to meet these varying conditions.

The object to be attained by the employment of surveyors to take out the Quantities of a building is to afford the builders who are to tender one uniform basis for competition, and to define more exactly and accurately than can frequently be done by the general drawings and specification the exact amount and nature of the work to be executed; and as no employer should desire to obtain from his builder more work or greater value, and should not obtain less, than was included in the estimate, while on the other hand he should have the greatest facility to secure due allowance in the case of omission, *it would appear reasonable* that the Bills of Quantities, which should express, in an exact form, the intentions of the architect as set out in his general drawings and specification, ought to form a part of the contract, and be dealt with as a recognized exposition of the responsibilities of both employer and builder.

The established practice in London in the case of large and public works, by which one surveyor is nominated by the architect to represent the employer, and another by the builders to act for them, giving the construction of the work and the elucidation of the architect's ideas the advantage of the experience of two professional men, who consider each question from different points of view, has apparently for many years worked well; though in many cases the advantage derived from the engagement of two can only be considered nominal. There is an understanding that the surveyors so employed are responsible to the builder for the sufficiency of the Quantities supplied, and the general drawings and specification prepared by the architect being sufficient, the employer is guaranteed against any excess of cost, and the builder is held safe against loss from errors of quantity; on this system your Committee do not think it neccessary to make further remark, although some objections have been made to it by leading members of the profession, who prefer to adopt the course next mentioned.

Many eminent architects have adopted the course of nominating a surveyor who shall prepare the Quantities on his own responsibility, and, as far as the builder is concerned, such Quantities become practically a part of the contract. Your Committee thoroughly appreciate the great advantages which the architect (and no less the employer) may derive from the employment of a surveyor acquainted with all the details of design peculiar to the architect, and with his general manner of proceeding, and also how such an arrangement facilitates proceedings when time is insufficient for the preparation of drawings and specification in such full detail as would be necessary if a stranger were employed as the surveyor. They are, therefore, of opinion that this system may in such cases be advantageously adopted, provided always that the builder be relieved from any responsibility as regards the Quantities, and that the Bills be considered as representing the work to be done. The successful working of such a system must depend entirely on the ability and position of the surveyor employed, his relation to the architect, and the extent of the confidence which the builders tendering may repose in him.

It appears to be an ordinary custom in the provinces for the architect to supply the Quantities for the carrying out of his own designs; where this is done, it should be with the knowledge and concurrence of the employer, and the Quantities should form a part of the contract. The architect accepts the duty of providing the Quantities, and should not attempt to evade his responsibility by throwing on the builder, as is sometimes done, the labour and risk of checking them, a course which your Committee believe to be unsatisfactory, and in some cases likely to lead to great injustice.

Your Committee are of opinion that the practice of making the Bills of Quantities part of the contract has not been fully considered. Recognized or not, the Quantities should be invariably referred to as the interpretation of the general drawings and specification; and in all cases where they are supplied to the builder by the architect, or by a surveyor in whose nomination the builder has had no part, and who is not responsible to the builder, they should form part of the contract. At the same time, when once it is admitted that these documents are to form part of the contract, the necessity for the employment of more than one surveyor in their preparation vanishes.

The more general adoption of Quantities, the extension to country work of the system of measurement usual in London, the gradual modification of local terms and usages, and, not least, the discussions consequent on such meetings as the Conference, will all tend towards uniformity of practice; and as builders become more familiar with the London system of measurement, and the public better acquainted with the nature and bearings of the questions as to the employment of surveyors, and both recognize, when such acquaintance increases, the special advantages to be derived from the adoption of one or the other system of employing them, architects and surveyors will find it to the interests of their employers to adopt a uniform practice.

This report was read to the Conference meeting held June 14th, 1872, and after some discussion the Council were requested to re-appoint the Committee with the view to a further report being submitted to the next Conference. The Committee, thus re-appointed, reported on June 8th, 1874, the steps taken to obtain further information and expression of opinion, and that they had no modification to suggest in their former report, which they again submitted for consideration by the Conference. The Council, however, thought fit without communication with the Committee, to append to the report the following note:—

At a meeting of the Council of the Royal Institute of British Architects, held on Monday, the 8th of June, 1874, the above report having been received and discussed, it was Resolved,—That the Council of the Institute, having carefully considered the report submitted by the special Committee on the employment of surveyors, are of opinion that the principal suggestions contained therein, and which wholly originate from that Committee, viz., the incorporation in one form or other of the Quantities in a builder's contract, are so novel, and so much at variance with the existing practice, that the Council cannot advise the adoption of the report, and the Council feel that the whole question of the employment of surveyors demands much further consideration.

The report was discussed at the Conference of the same year, and on June 18, 1874, the following resolution was agreed to:—

That the best thanks of the Conference be given to Messrs. Cates and Rickman for their care in the preparation of their report. That the report be received, and the Council be requested to bring the matter before a future meeting of the Conference, when further information on the subject may be accessible.

Beyond articles in the professional journals nothing further was done till, on May 19, 1879, my friend, Mr. John Honeyman, read in this room a Paper on "Bills of Quantities and their Proper Relation to Contracts," in which he advocated the adoption of the Glasgow system, by which tenders are invited on somewhat speculative or approximate Bills of Quantities—the work as executed being measured up when finished. On April 12, 1880, Mr. C. G. Saunders read before the Institution of Surveyors an excellent Paper on "Quantities and Quantity Practice," and in the discussion which followed I ventured to submit for consideration a series of propositions which have been styled "The Surveyor's Decalogue" or "Charter," namely:—

1. That when tenders are required from a number of builders for the erection of a building, it is essential that Bills of Quantities should be prepared, in order that each of them may make his tender on identically the same basis.

2. That, in the absence of special instructions to the contrary, it is the duty of the architect to make the necessary arrangements for the providing of such Bills of Quantities.

3. That, for this purpose, the architect is the agent of his client, and the client is bound by his acts, whether cognizant or not of them, or of the custom.

4. That, until a tender is accepted, the client is liable to the surveyor, so appointed by the architect, for the amount of his commission and the expenses incurred.

5. That, on the acceptance of a *bonâ fide* tender, the liability to the surveyor shifts from the client to the builder; the surveyor accepts the builder as responsible to him, and his right of claim against the client ceases.

6. That, if the work is abandoned before a tender is accepted, and contract entered into, the client pays the surveyor; if after, the accepted builder pays, and has his remedy against the client.

7. That, as a matter of convenience, it is the custom that the architect should include, and it is an obligation on the architect so to include, in his first certificate, such reasonable charges and expenses of the surveyor; but the liability of the builder is not affected by this practice, and commences immediately on the acceptance of his tender.

8. That a surveyor employed directly and solely by the builder, without the intervention or concurrence of the architect, has no claim against the client, and must look for payment to those who employed him, and on whose instructions he acted.

9. That there are circumstances under which an architect may make himself personally liable to a surveyor, but they are of infrequent occurrence, and are not likely to arise with architects of any standing or repute.

10. That the surveyor is liable to the builder for proved inaccuracies or deficiences in the Quantities, and it is an obligation on him to prepare his Quantities with the utmost care and accuracy, that the client may not suffer by excess, or the builder by want therein, and to fulfil his important duties with the strictest honour and integrity.

These discussions were followed, on November 22nd, 1880, by a valuable Paper by Mr. Francis Turner (barrister-at-law) on "The Law as affecting Quantity-surveyors." And thus the architects and the surveyors having discussed Quantities, the builders, to whom, perhaps, the subject is of as much importance as to anyone concerned, also had it brought before them at a meeting of the National Association of Master Builders of Great Britain, held at Bristol, July 27th, 1880. Mr. Edward Hughes, of Liverpool, read a Paper on "Bills of Quantities and Measuring Builders' Work," which well deserves perusal.*

There has thus been brought forward a large amount of information as regards practice, and numerous expressions of opinion—frequently diverse, because based on different grounds; and the discussion to be held in this room should further the advance of knowledge on the subject, and enable us to arrive at some definite principles of practice. There is but one more observation which I desire to make, the necessity for which I should gladly have avoided, but it does not seem expedient to pass it by. From statements which recently were made to the Council, with reference to the relations alleged to exist in some instances between architects and the Quantity-surveyors they employed, the Council considered it desirable to publish a declaration of their opinion thereon, and in No. 5 of the PROCEEDINGS, 1880-81, such declaration was published as follows:—

Sharing Commissions with Quantity-surveyors.—It having recently been stated to the Council of the Royal Institute of British Architects that the charges made by Quantity-surveyors are sometimes shared by the architect, and such a practice, if it really exist, being open to great and obvious objection, the Council hereby publicly declare that, for the future such practice, if proved, will be deemed conduct which, in the opinion of the Council, is derogatory to the professional character of any Fellow or any Associate of the Institute.

Anyone who may desire to ascertain the full bearing and import of the declaration may refer to By-law XXIII., when he will fully appreciate it.

The subject may, in the discussion, be considered under the following heads:—

1. Is it desirable or expedient that architects should themselves, or by some person in their employ, supply Quantities for works to be executed under their direction?

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* Extracts from this Paper were subsequently read, and they will be found at page 252 of the present volume.

2. If the Quantities are supplied by the architect, or by some person in his employ, should they not form part of the contract?

3. In the like circumstances, should not payment for the Quantities be made by the client direct?

4. Is it not the duty of the person who takes out the Quantities to supply to the builder at his request, and at his cost for copying, a certified copy of the dimensions on which the bills are based?

5. Is it not an obligation on the architect to include the amount of the surveyor's charges and expenses in the first certificate he gives to the builder?

*** The following Papers, *a, b, c, d*, were then read, namely:—

(*a*) THE RELATIVE RESPONSIBILITIES OF ARCHITECT AND SURVEYOR IN RELATION TO QUANTITIES. By Mr. Sidney Young.

Mr. Chairman.—The points which I desire to bring under the notice of this Conference are the legal responsibilities and remedies of the Quantity-surveyor, and in doing so I shall confine myself to what I consider his actual position in reference to the building owner and to the builder, leaving the questions of the desirability of amendment on those points, and of the settlement of a definite rule of practice, to others more experienced than myself. I shall therefore endeavour, without arguing the rights or wrongs of the various positions, to state as simply as I can, from a surveyor's point of view, the footing upon which I conceive the Quantity-surveyor stands with regards to his employers.

The best and most careful of men in all professions and callings are, and ever will be, liable to errors, even though exercising their skill in a painstaking and careful manner, and if the Quantity-surveyor could be happily exempt from this common failing of human nature, he has behind him his clerk, who often makes a mistake for him. Of the blunders made by surveyors I believe a large percentage are clerk's errors in squaring, abstracting, or checking. But they are errors, and the surveyor, on the well-known principle "*Qui facit per alium facit per se*," is liable for them. But to whom is he liable? The answer undoubtedly is, to the person with whom he has contracted. But who is that person? Let us see. It is essential to every contract that there should be two parties to it—namely, the party agreeing and the party agreed with. In the subject under notice the surveyor is one of those parties. Who is the other? It is either the building owner or the builder, but I contend that it cannot be both at the same time, and I shall endeavour to show in what cases it may be either one or the other. Before, however, I do so I would wish to refer to the case which (under certain circumstances) is looked on by Quantity-surveyors as their sheet-anchor, namely, Moon *v.* The Guardians of Witney Union—a case tried so far back as 1837, since followed in numerous actions, and as yet not overruled. The guardians authorized their architect, Mr. Kempthorne, to prepare plans and specification for a new workhouse, and also to obtain tenders. Mr. Kempthorne instructed Mr. Moon to take out the Quantities, which he did; but in the meantime the guardians changed their minds, and decided to abandon the work. Mr. Moon brought his action against them to recover his charges, and the Court holding that the architect, as agent

for the defendants, had authority to bind them in a contract with the plaintiff, such contract being a *conditional* one, in the words of Chief Justice Tindal, "a contract by which it was arranged that the expenses of making out the Quantities should be paid for by the successful competitor, if any; but if by the act of the defendants there should be no competition, then that the work which was done by their authority should be paid for by them." If, however, a tender had been accepted, the contract would have shifted and been taken to subsist as between the successful builder and the surveyor. Mr. Moon obtained a verdict, and, as I have observed, his case has been succeeded by others, in which the same principle has been followed. Now, here was a type of case in which the building owner, by his default in failing to accept a tender, precluded the surveyor from obtaining his charges from the builder, and I venture to think that no one, either in the profession or out of it, would question the righteousness of the decision. But supposing a tender had been accepted, the surveyor could only have recovered his charges from the builder; and had the builder become bankrupt the day after his tender was accepted, the surveyor would (as I shall presently prove) have been in the happy position of one of his creditors, his remedy against the guardians would have been gone.

Now, I would assert the proposition, and I believe it to be sound in law, that the surveyor is responsible for errors to the person with whom he contracts—in other words, to the person who pays him, and, if the builder pays him, to the builder only can he be liable for errors in Quantities. I do not know of a case in which a building owner has ever sued a surveyor who had been paid by the builder, for *excess* in Quantities, in which he recovered; but cases the other way, in which the builder, having paid the surveyor, has recovered from him for *deficiencies* in his Quantities, will present themselves to the recollection of many gentlemen here.

The War Department have perhaps employed Quantity-surveyors to a greater extent than any other body in the kingdom, and recognizing, as I believe, the principle I seek to maintain, drew up a circular on the appointment of surveyors in which they fixed the responsibility of those acting for them by paying them direct, and not allowing their charges to go through the builder. By this means they made a special contract out of the ordinary usage and custom, retaining the services of the surveyor on their behalf, paying him for such services, and looking to him for errors made against them in taking off the Quantities; and I should contend that, in a case like that, the builder could have no claim against the surveyor for deficiency in Quantities, for the simple reason that he (the builder) took the Quantities with the knowledge that they would be paid for by some one else, and without any money or other consideration passing between him and the surveyor. But the War Department go further in their dealings with surveyors, for builders tendering are summoned to meet and appoint a surveyor on their own behalf, to sit down with the War Department surveyor and prepare the estimate, and their—that is, the builders'—surveyor is *also* to be paid direct by the War Department. This would, I apprehend, make the builders' surveyor liable alike to the War Department and to the builder; for the surveyor *accepts* the appointment from the builders, and impliedly contracts with them that he will take out the Quantities for them, though, *contrary to the usage*, he will receive his charges from another party. In cases like this only, I think, can a surveyor be in the unfortunate position of finding himself liable to both parties.

Formerly it was the practice for each builder to take out the Quantities for himself, and that with more or less detail; but it subsequently was found more convenient to employ surveyors, to save the labour thus thrown upon builders, who have over and over again met and appointed surveyors to act for them, and this irrespective of any appointment by the architect. Could it be contended in cases of that description that any liability existed on the part of the surveyor to the building owner? Now, this method of appointing a surveyor was from a builder's point of view preferable, but it was attended with too much loss of time, trouble and inconvenience, and moreover there was a third party, the architect, whom it was naturally felt was entitled to have something to say as to the appointment. The surveyor would have to go to the architect for the drawings and specification, and obtain from him the necessary information to enable him to do his work, hence it is obvious, that a surveyor of respectability with whom the architect could arrange for the use of the drawings and specification, in whom he had confidence, and who was conversant with the peculiarity of his style, details, and methods of construction, would be the man before others to take out that particular architect's Quantities; and the builders therefore virtually delegated the appointment to the architect, in effect saying, "for the purpose of our making our estimate we require a surveyor who shall take out the Quantities for us, but, as our meeting together would involve a loss of time to many, and as moreover we might appoint a surveyor who would be distasteful to you, we leave the appointment in your hands, for you to name some respectable man who will be satisfactory to us, and if any of us disapprove of him, why, such need not tender." This I think is really the way in which architects have acquired the appointment of surveyors, but I do not think that it the more makes the person so appointed anything else than the builder's surveyor, unless a special intimation be given to the surveyor at the time that he is to act for the building owner, and to be paid by him direct. I am aware that surveyors, almost without exception, consider their appointment by the architect as an appointment in the interest of the building owner, in other words that they are to take the Quantities as closely and accurately as may be, and it is well that they should so regard their position.

It may be alleged against my argument that as the surveyor is thus indirectly appointed by the builders, he ought not to be able to recover against the building owner in such circumstances as those referred to in Moon *v.* the Witney Union; to that I would answer that it is most proper he should have the privilege of doing so, and for this reason, that the building owner, after having by his architect asked for tenders, may, if he chooses, waver in his original intention, and thus be the means of having caused a great deal of trouble and expense to a person who has been engaged in performing an arduous duty, for the purpose of supplying him with a particular and valuable information, namely, the cost of his intended house, and it would seem from the judgment in that case that the Court, in this most reasonable light, so looked upon the matter.

It is frequently said that surveyors must not shut their eyes to the fact that their charges, which are included in the Bills of Quantities, come out of the building owner's pocket, and therefore that they are his agents and liable to him; but, if that is so, then are the merchants, who supply the bricks, stone and timber to the builder, also in the same position, for the costs and charges of their work and materials are also set down in the Bills of Quantities, and

likewise come out of the building owner's pocket; yet, where is the building owner who, passing over his builder, would make a claim against the timber merchant who supplied the builder, for that sappy or inferior timber had been introduced into the building?

I may perhaps be pardoned for here introducing a case in which I was the plaintiff, and to which I would otherwise be unwilling to refer did it not forcibly illustrate the principle of non-liability on the part of the building owner. The facts, as proved at the trial, briefly were these: The defendant employed an architect, who, with his knowledge, instructed plaintiff to take out Quantities for his house; plaintiff took out the Quantities, tenders came in, plaintiff's charges were included in the summary; a tender was accepted (the defendant being shown the summary before the contract was signed, and being informed of the amount included for plaintiff). The work went on, defendant requested his architect not to include plaintiff's charges in any of the earlier certificates, with the intention of keeping such certificates at as moderate an amount as possible. Work to the value of £1,400 was executed, and certificates granted for £1,100. The builder failed; defendant took the work out of builder's hands and employed another builder to complete. Previous to this, plaintiff had applied to builder for his charges and (on being told they had not been included in any certificate) sued the defendant on the ground that he (the defendant) had by design prevented the plaintiff from obtaining the charges in the usual way. This case was tried in the Court of Queen's Bench, on December 3rd and 4th, 1879, before Mr. Justice Field, who nonsuited me, and a copy of whose judgment *in extenso* was published in the *Building News* of December 10th, 1880. Considering the injustice of the case, and the sympathy expressed for me by the judge who found against me, I went to the Court of Appeal, where, on the 27th May last, the case was heard before Lord Justices Bramwell, Baggallay and Brett, who, after hearing my counsel, and without calling on the defendant's counsel, dismissed the appeal with costs. I therefore had the misfortune to assist this building owner to obtain his tenders, to pay a considerable sum for lithography, and then to spend between £200 and £300 to find out that he did not owe me anything for my services.

Now, as the decision of the Court of Appeal in my case against Dr. Smith is to the effect that the building owner is exempt from liability for surveyor's charges when the contract is signed with the builder, is it reasonable or equitable to suppose that any liability should exist on the part of one man towards another, with whom the law says he has no contract by which he can recover his charges? Surely if A is not liable to pay B for work he has done, B cannot be liable to A for the manner in which he did that work.

I think I need say but very little as to the liability of the surveyor to the builder. In usual cases, namely, those in which the charges are included in the summary and paid by the builder, the surveyor is undoubtedly liable to the builder for errors of omission or misdescription in his Quantities, although the equity even of this might very well be questioned.

There is a case, Scrivener *v.* Pask, which was tried in the Common Pleas, in which the plaintiff was a builder and the defendant a building owner. Quantities had been taken out by the defendant's architect, and the plaintiff, under the impression that the architect was the agent of the defendant, sued the defendant for alleged omissions in the Quantities, but was nonsuited; and on appeal to the Court of Exchequer Chamber, the decision of the Court

below was upheld. In this case it would appear that the architect was agent for the defendant in so far as he acted as his architect, but not his agent in the matter of Quantities, they having been paid for by the plaintiff-builder to the architect, acting in his capacity as Quantity-surveyor, and thereby a contract subsisted between the builder and the surveyor, by which the latter alone rendered himself liable to the former. In the judgment in the Court of Appeal, Mr. Justice Blackburn remarked:—"To entitle the plaintiffs to recover they must make out three things, that the Quantity-surveyor was the defendant's agent, that he was guilty of fraud or mis-representation, and that the defendant knew of and sanctioned it. There is no evidence here of either of these things. If there has been misconduct on the part of the Quantity-surveyor the plaintiffs have their remedy against him."

This very important case settled two points: 1st. That if the Quantity-surveyor issued insufficient quantities the remedy of the builder was not against the building owner, but, (said by Mr. Justice Blackburn) to be against the Quantity-surveyor. 2nd. That the Quantity-surveyor was not the agent of the building owner.

In a very valuable Paper on the Law as affecting Quantity-surveyors, read before the Institution of Surveyors by my friend Mr. Francis Turner, is a paragraph so forcibly illustrating by analogy the principle of non-liability on the part of the surveyor to the building owner that I venture to repeat it here. "It would be anomalous," said Mr. Turner, "in the extreme, if the building owner, being neither liable to the Quantity-surveyor nor responsible for him, could maintain an action against him. He would be like the plaintiff who sued the solicitor whom a testator had employed to make a will by which he would have largely benefited, had not the solicitor unluckily made a mistake in the execution which rendered the will inoperative, but who failed in his suit* because the solicitor had never contracted with him."

The case of Scrivener *v.* Pask before alluded to, does something more than settle the two points to which I referred, it calls our attention to the practice unhappily widespread, of the architect supplying his own Quantities. It may be said that as a Quantity-surveyor I naturally join in the outcry against this system, but I would disdain doing so on that ground, and say that my conviction is, from cases which have come under my notice, that the system is a pernicious one.

It begins in secrecy. Where is the architect who in these cases faces his building owner at the outset with the statement, "You will have to pay me five per cent. for acting as your architect, and two or two-and-a-half per cent. for acting as your surveyor?" I may by way of parenthesis remark, that the rule is, the worse and more slovenly the Quantities, the higher the charge, and hence architect's Quantities are generally sent out with a higher rate of commission affixed to them than are those prepared by surveyors. Well, having, or as the probabilities are, *not* having told his employer that he is going to take out the Quantities, what does he do? In nine out of ten cases he delegates the work to a clerk in his office, a man who, as a general rule, can do everything, survey dilapidations, prepare perspectives, take out Quantities, make detail and working drawings, a factotum who knows a little of everything, but a man who, I venture to say, cannot compare in point of intelligence and aptitude for this

* Robertson *v.* Fleming, 4, Macqueen's Scotch Appeals, 177.

particular work with the surveyor whose training has always been Quantities and nothing else. It may be urged by some architects that they *bonâ fide* take out the Quantities themselves, and to this I would answer that if they do, they cannot do it as satisfactorily as a surveyor would, and for these reasons:—1st. If the architect be a man in large practice he would not be able to isolate himself from the more important branches of his profession, neglecting his clients, his works and his drawings, and devoting long hours to the mysteries of "beds, joints and plain faces." 2nd. If he be a man in small practice who urges that he has plenty of time at his disposal, no rich clients calling, important works to visit, or details to settle, I reply that, for that very reason, his opportunities of having acquired a knowledge of the profession of the Quantity-surveyor must be so limited, as to suggest the desirability of his placing his work in the hands of some one who knows how to do it. Say what Quantity-architects will, it is after all a question of £. s. d. with them, a means of bringing them into a position in which they should never be placed, namely, that of receiving fees from builders whose work they have to criticize, control and certify for. I hold that, in the matter of money transactions, the builder and architect should be kept at an absolutely unapproachable distance. There is also this further consideration, the architect, being paid his fees as architect by the building owner, has, or ought to have, a desire that his client should get the full benefit of his services; how can that be so, however, in cases where errors have been subsequently discovered as against the builder? The builder then has to settle them with Mr. Face-both-ways, and the probability is that the building owner goes to the wall.

Then again, builders (who have a right to be considered) do not like architect's Quantities, and I believe that if there were more cohesion in the building trade, such Quantities would be returned, and the practice die out—but the jealousy existing among builders prevents their refusing to tender upon architect's Quantities, and thus they grumble and continue as a body to tolerate a system which as individuals they dislike.

I can see every disadvantage as resulting from the practice of architects taking out Quantities for their own works, whilst on the contrary the employment of the trained surveyor presents a distinct advantage to the architect, as by the process of analysis brought to bear upon his work, the surveyor is frequently able to detect wants in detail or specification, and questionable points in construction which had escaped the architect, and which he is glad to rectify before the contract is signed; it also presents another advantage in giving to builders Quantities which they can understand, and know are prepared by an independent party, and it relieves the architect from the stigma which must attach to him when he takes money from the builder working under him.

There are many points in reference to Quantities upon which I should like to enlarge, but which would extend this Paper far beyond your patience, and so I will briefly touch upon some of them. The practice of architects sharing in the surveyor's charges has already received practical attention at the hands of the Council of this Institute, and is so reprehensible that I need say nothing further about it except to express the hope that it is fast disappearing from amongst us. Then as to "making Quantities part of the contract." This subject has been much canvassed of late and is well worthy of full discussion, though it is a point upon which I do not think a hard and fast line can be drawn. There is, however, one event in which I am of opinion that Quantities should form part of the contract, and that is when they are taken out by

the architect; some other cases occur to me in which it is also desirable, but as a general rule they should not form part of the contract. The surveyor should so take out his Quantities that he can stand to the correctness of them as a whole, and not desire to thus shield himself from responsibility for errors.

I should like to call attention very briefly to a class of advertizement which is being issued by the Commissioners of Her Majesty's Works and Public Buildings, a copy of one of which is before me. It there states:—

> "TO BUILDERS. The Commissioners of Her Majesty's Works and Public Buildings are prepared to receive TENDERS for the ERECTION of a New POST OFFICE at Manchester.
>
> "Persons desirous of Tendering should apply at this Office, where the Plans, Specifications, and a copy of the Form of Contract can be seen on and after Tuesday, the 1st of March next, between the hours of eleven a.m. and four p.m., and where also Bills of Quantities and a Form of Tender can be obtained on payment of the sum of £2. 2s. The Commissioners do not hold themselves responsible for the accuracy of the Bills of Quantities, *which must be verified by the persons desirous of Tendering*, nor do the Commissioners bind themselves to accept the lowest or any Tender. The Tenders are to be delivered before twelve o'clock on TUESDAY, the 22nd March, addressed to the Secretary, H. M. Office of Works, No. 12, Whitehall-Place, London, S.W., and must be endorsed 'Tender for Manchester New Post Office.'
>
> "H. M. Office of Works, Feb. 22, 1881. A. B. MITFORD, Secretary."

We have sometimes heard of the onus of proving the correctness of Quantities being thrown upon builders by unscrupulous architects, who, having taken out their own Quantities and charged two-and-a-half per cent. for them, are so frightened of their work, that they compel the builder to sign a document to the effect, that he has examined the Quantities, is perfectly satisfied as to their accuracy, and that he relieves the architect-surveyor from all responsibility. But to think that, after years of experience in the matter of Quantities, the Office of Works should have at last woke-up to the desirability of imitating such practices is astonishing, and I trust that builders will show they have some spirit left by not binding themselves hand and foot to Quantities which have been taken out by some one in whose appointment they have had no voice. The Office of Works might have advertized that they disclaimed all responsibility for the accuracy of the Quantities, and have left the builder to settle with the surveyor should occasion arise, but to cast upon him the burden of proving and approving Quantities in this high-handed manner, will not commend itself to the profession generally or to the building trade.

I believe that all these matters would be greatly simplified, and put upon their proper basis, were surveyors recognized and paid direct by the building owner, and I hope that steps will be taken to bring about so desirable an end.

And now reverting to the former part of my subject, I desire to submit four propositions as illustrative of the responsibilities and liabilities of a surveyor; before doing so, however, I must observe that the general position of all parties as they do, or rather ought to, exist is very clearly set out in the "Surveyor's Decalogue" prepared by Mr. Arthur Cates, though I would, with all deference to that gentleman, venture to suggest that a clause should be added on "the responsibility of the Surveyor to the Building Owner," which responsibility has sometimes formed a very painful episode in the surveyor's history. My propositions are these:—

1. An architect may employ a Quantity-surveyor to take out Quantities, and if, by default

of the building owner, no contract is entered into, then the building owner is liable to the surveyor for the charges (Moore *v.* Witney Union, Gwyther *v.* Gaze).

2. If, however, a contract is entered into with a builder, the contract to pay the surveyor's charges by the building owner at once shifts to the builder, who only is then liable to the surveyor (Young *v.* Smith).

3. In that event the surveyor is liable to the builder only for errors in Quantities.

4. In cases where the building owner employs and pays direct the surveyor, such surveyor is liable to the building owner only.

(*b*) QUANTITIES: LONDON AND PROVINCIAL PROCEDURE.

By John G. Elgood, *Associate.*

Mr. Chairman.—The prevalent system practised in London of appointing two independent surveyors, one on behalf of the client and the other of the builders is well understood, and does not call for particular remark; in large works it is obviously a good and equitable arrangement, and one which will continue to prevail, but in smaller works it seems unnecessary to divide the work and labour, and I suppose is not ordinarily done. The recognized charge appears to be 1½ per cent. (in addition to the cost of lithography), but this is by no means universal. It would be preferable, of course, as a matter of principle, to put it upon the builders to take off the Quantities for themselves, wherever practicable.

The system above referred to does not prevail to any appreciable extent in the provinces, nor is there any recognized custom instead of it. Various methods (and want of method) and different practices are adopted to suit individual ideas or convenience; in some cases, perhaps the majority, architects take the Quantities for their own work, and charge various rates from 1 up to 2½ per cent. according to their own notion of the value of the work, and almost invariably the charge is made in the bill, and paid by the successful contractor. In exceptional cases an independent surveyor may be appointed on behalf of the client and paid by him, when the arrangement assimilates itself to that usual in London, but it is mostly limited to the employment of one surveyor. In Scotland an entirely different system prevails: in the first instance approximate Quantities are taken out and the bills priced, which serve as the basis of settlement at the end of the work, when the whole is re-measured. It is very important that a recognized scale of charges should be laid down for taking out, and in order to provide for the increased labour of small works a sliding scale might be adopted, ranging from 1 per cent. for very large works to 2½ per cent. for very small ones. One objection to the independent surveyor is that it brings in another authority between the proprietor and architect, in some cases giving him practically all the power in the settlement of accounts and money matters, which is not altogether a pleasant position for the architect, who in all other questions has power to determine in case of dispute or difference. All kinds of methods have been devized by architects and surveyors issuing Quantities to protect themselves from responsibility, some very absurd, unfair and inequitable. Most Bills start with a heading disclaiming any liability for their accuracy, and in many cases throwing the burden of proof on the builder, who (though paying for the work being done) is required to check the accuracy of the calculations for himself, which is practically an impossibility. An example of this is given in an advertizement just issued to contractors for a government work—the new Post Office at Manchester. I think the greatest mischief in connection with this subject has arisen from the attempt to evade the responsibility. It is manifestly unfair and would not hold good in case of a dispute, and matters being pressed to a legal issue—the result being that the subject is found too complex and technical to be settled in a court of law and referred to arbitration, with usually a costly and unsatisfactory ending, arrived at by the practice of "splitting the difference."

The only satisfactory remedy which occurs to my mind, after an experience of some years, and acquaintance with various methods of procedure, is to make in all cases the Quantities *a part of the contract*, by whomsoever they may be prepared. This would render it of little consequence whether they were taken out and issued by architects themselves for their own works, or by an independent surveyor. It would prevent any liability of abuse, and be perfectly fair and equitable to both parties. Any inaccuracies would be adjusted at the final settlement of accounts, and a satisfactory result arrived at for both client and contractor. All might then be done fairly and above-board, payment being made by the proprietor direct; the builders would know they were secure of honourable treatment, and be able to price their work without fear of nameless and undefined

pains and penalties. The objection raised is that the proprietor would not know what he is going to pay, but there does not seem to be any great force in it, and it might naturally be expected to make him more careful i selecting a competent man. A suggestion has been made in connexion with this subject, to obviate the objection which the leading London architects, and some provincial ones of first-rate standing, have to taking Quantities in any form, that the Associates might be allowed as at present to continue to do so, but that in future Fellows should be debarred. There can be no objection to this course if the present Fellows are willing, but if they cannot agree to do so at once, it might come into operation in 1882, at the same time as the obligatory Examination. It would also be advisable, in my opinion, to define more exactly what is meant in the Declaration signed by all Members on election, that "I will not have any interest or participation in any trade contract or materials supplied at any works, the execution of which I may be engaged to superintend,"—and how this applies in cases where architects invent or introduce specialities in sanitary matters, warming and ventilation, selenitic mortar, zinc roofing or similar materials, whether patented or otherwise.

(c) QUANTITIES: THE EDINBURGH SYSTEM. By Mr. Robert Morham.

Mr. Chairman.—I have been asked to give information on the professional position of surveyors of builders' work in Edinburgh. It might be considered that questions relating to the profession of the surveyor, or measurer, as he is usually called in Edinburgh, could be best treated of by one of that profession; but, in view of the special matters on which I understand information is chiefly desired at the present stage—namely, the relations of the measurer with the employer, architect and builder—an architect may on the whole be in a better position to deal with the various aspects in that connection than even a member of the profession under review. I have therefore, though not myself a measurer, been induced to comply with the request made to me to give an account of these relations, as usually subsisting in Edinburgh, and with your leave, shall now endeavour to do so. In treating of the subject of Quantities, more than one recent writer has made favourable allusion to the system prevailing in Edinburgh, or more generally in Scotland. But, while such recommendations may be so far well merited, and our methods in certain respects worthy of consideration by our neighbours, it does not follow that our general practice is, to the extent which might be desired, the subject of a well-defined system, and in fact it is not so. Among Edinburgh measurers, indeed, there is a fairly uniform *understanding* on the subject, but no authoritative definition of their professional position, nor are its general principles and practice so well determined but that sundry changes are found from time to time working their way, while the system, such as it is, differs materially in some respects from those followed in other districts. After careful consideration, however, I venture to think that, with certain modifications and improvements, the practice of measuring as followed in Edinburgh might eventually be found to contain the elements of an equitable medium between that system on the one hand, which devolves all risk of error on the measurer, and that which, in undue haste to invest in stone and lime, contents itself with an approximate estimate only, leaving the actual cost very doubtful until the building is completed. We hold it quite reasonable and proper, that an employer should desire to be informed beforehand what an intended building is to cost, as planned; and that with due care this information is attainable to a fair degree of certainty; but, on the other hand, that, except in respect of professional credit, it is inexpedient that the measurer should be liable for ordinary errors, which (though it would appear that in any work of considerable extent they cannot be altogether avoided even with the best practitioners) are yet, in schedules prepared with ordinary care, seldom of serious extent, and are as likely to be in the employer's favour as not. In what follows, I propose to state briefly the public qualification of our Edinburgh measurers; next, the nature of the common understanding of their professional position with regard to employers, architects and builders; and then to offer a few remarks on certain matters of detail.

The measurer is with us a public official, and probably the only professional man who, though without salary or specific duties, holds his appointment from the local authority. His, in fact, is a public appointment shared by an indefinite number of fellow officials. An aspirant to the dignity makes application to the authorities who then remit to two surveyors of good repute to examine him as to proficiency in the craft, and on their favourable report he enters into a regular bond, under penalty to act honestly and fairly in all questions intrusted to him, and having further taken the oath to be faithful, in due form before the magistrate, he thus becomes an Ordained Surveyor, or, in more homely phrase, a "sworn measurer."

The various points in the measurer's professional relations, in connection with such works he is employed on, may be summarized as follows:—He is appointed on behalf of, if not by, the employer. For general integrity,

he is responsible to the public authority, in other respects he is properly responsible to the employer. He is, or should be, furnished by the architect with full documentary information, sufficient to enable him to prepare schedules of the quantities of materials and work of the various kinds intended in the proposed building. The fees for measuring and lithographing are added as special items at the end of the schedule, and included in the builder's estimate, and are usually payable from his first instalment. The usual fee is one per cent. on the estimate, exclusive of the cost of lithographing schedules. The accuracy of the measurements is not guaranteed. The builder is required immediately on the acceptance of the estimate to furnish the architect with the priced schedule for the purpose of pricing extras and deductions, if any should occur. The amount of these is ascertained and certified by the measurer, who usually also applies the prices and extends the account, charging along with it in a separate item his own remuneration for this additional work, according to the trouble involved, and receiving it afterwards from the builder. Total measurement of the work as executed is only resorted to in cases of extensive deviation from the contract plans. Some architects, either under their own hand or by employing qualified surveyors in their offices, prepare the schedules for their own works, but this system is not generally viewed with favour nor extensively practised.

Proceeding now to refer somewhat more in detail to certain of these points, I would remark :—

I. With regard to the appointment of the measurer. Though in most cases he is appointed by the architect, it is understood to be on behalf of the employer, who otherwise may, if he think proper, exercise his prerogative and himself nominate the measurer; but the nature of the measurer's duties is generally so little understood by employers that in most cases the choice is left to the architect. It is quite unusual in general practice for the builder to have any voice in the appointment of the measurer; indeed, the idea of anything like a meeting of intending estimators is contrary to the spirit of the locality, the tendency being rather to keep the names of competitors a profound secret from the others, for the purpose not only of preventing collusion among them, but also of securing the measurer's independence and freedom from risk of undue interference; and in the course of an experience extending over a good many years I remember only one case, and for it there were special reasons, in which the intending estimators were invited to meet and appoint the measurer. Notwithstanding this non-participation of the builder in the appointing, it used to be contended that the measurer is the builder's servant, and it is not difficult to see how this view has originated. The principle, indeed, is still acted on in contracts taken by H.M. Commissioners of Woods and Forests—no mean authority—but in all other ordinary practice it has become nearly, if not quite, obsolete, and, though the fees are paid by the builder, it is only the very ignorant who do not know that he first receives them from the employer.

II. As regards responsibility for the accuracy of the schedules, it used formerly to be provided in the specification that contractors would be held to have satisfied themselves as to the accuracy of the measurements, and that no after-claims on account of errors in the schedules should be entertained. This was of course with the intention of divesting the employer of responsibility, and the builder had thus to choose between running the risk of the schedule being incorrect or incurring the expense of a second measurement to check the first. In the vast majority of cases the builders preferred to run the risk, and take their chance of over measurements to counterbalance omissions; but as omissions somehow usually impress themselves on the builder's observation as the work goes on, in a way which over-measurements entirely fail to do, it not unfrequently came to be that the builder declined to abide by such provisions, and the Court, when called upon to interfere, decided that the builder could not reasonably be held responsible for inaccuracies in the measurer's work. The measurer not being responsible except with his professional credit, the risk thus devolves on the employer, who of course is entitled, on the other hand, to a deduction in respect of over-measurements, provided these are duly seen to on his behalf. The risk must lie somewhere, and it is considered with us that on the whole the fairest course is to let it lie with the employer, and that the system of paying the measurer a larger fee in respect of his taking the risk is open to very serious objections. This rule, however, is not so binding but that a measurer may, if he think proper, voluntarily make good the defects of his work, and a case occurs to my recollection in which a firm of measurers, having discovered a serious under-measurement in their schedules after the contract was taken, of their own accord paid for the deficiencies. It may be left to the moralist to say how far they were right in the abstract; but pecuniary self-immolation is in our northern climate a plant of such rare growth, and has such a strong flavour of virtue, that ordinary criticism is disarmed in its presence. Such occurrences are, however, not common, and I record this case rather for example than for precept. Some of our measurers take care to add to their schedules a note that the Quantities are not guaranteed; others annex the mystical letters "E. E." which, being interpreted, mean "Errors excepted"; or, even more astutely, "E. and O. E."—"Errors and omissions excepted"; but these precautions are of no avail in devolving liability on the builder, and even where they are not taken, the builder is no longer, as a rule, held liable for the accuracy of a document

he has had no hand in preparing or even ordering, while I am not aware of any case in which the measurer has been found liable in law for defects in his measurement. Of course, where gross carelessness or intentional untruthfulness could be demonstrated, the case would be different; but, as a rule, the measurer is thus responsible for his errors to the employer, but that only, with his good name.

III. Passing on to consider the assistance given to the measurer by the architect, it may be remarked that, where proper drawings and specifications are supplied, the measurer can prepare his schedules with little or no further reference to the architect. There appears, however, to be a growing dislike on the part of some of our architects for specification writing. Some prefer to give detail drawings with copious notes, and only a general specification. There can be no objection to this, provided the information given to the surveyor be adequately placed on record. Others, whether from want of time or some less excusable cause, take the free-and-easy plan of giving the measurer only general drawings, or it may be mere rough sketches, and perhaps a few verbal explanations, leaving him for the rest to his own resources; but they usually neglect to deduct from their own fees, and hand over to the measurer, the just proportion thereof pertaining to the work they thus devolve on him. I have heard complaints by several measurers on this subject, and the habit appears to me most irregular and even unfair, and something like an unwarrantable advantage taken of the measurer's position, the possibility of which it should be one of the aims of a well-established system to preclude. Well-matured plans and specifications are indispensable in some form or other for an accurate estimate, as well as for the proper execution of the work, and are clearly part of the architect's duty, that of the measurer's being to supply information, to estimators, of the quantities and descriptions of materials and work required, as set forth in the architect's plans and specification. If, however, it is found that an experienced measurer can make his schedules answer for the specification with less trouble than it takes the architect to prepare one in the old way, by all means let it be so, but let the remuneration be regulated accordingly. Otherwise, let such architects say openly that they do not include the specification as part of their services.

IV. With regard to the relation of the measurements to the contract, at no very remote date it was the rule expressly to exclude them, except for the purpose of valuing extras and deductions, and make the contract otherwise refer to the plans and specification only. The first general condition of contract in the Edinburgh Rules, as to the measurement of mason's work, is, however, aimed directly at this view, and provides that the contract is to be based on the schedule; and it is now usual for contractors expressly to limit their offers to the extent of the schedule of measurement. Of course, where the schedule is also the specification, this limitation cannot with any show of reason be denied; but even where a separate specification is provided, there seems no good reason why the schedules of measurement should not also be embodied in the contract, especially where the principle of holding the builder liable for inaccuracy in the measurements is no longer maintained.

V. On the subject of remuneration, one per cent. must sound to those accustomed to a higher rate rather bare, even where, as with our measurers, the Quantities are not guaranteed; and between growing demands by the builders for detailed information, and exactions by architects such as those before referred to, there are indications of a feeling of discontent with the old rate, further fostered no doubt by rumours of considerably higher rates paid in some other places, even though those higher rates do embrace liability for errors. For additional work there should in fairness be additional pay, and if, as I believe, the fuller analysis demanded by the builders tends to the employer getting his work more nearly at cost price, an increase of remuneration on this ground should be willingly accorded. But care should be taken to distinguish between work arising out of new exigences of trade and such as may be simply demitted by the architect. A well-considered system for general adoption, such as it is the object of this Conference to establish, would no doubt greatly tend to the satisfactory settlement of such questions.

On the whole, our system of measuring has hitherto been found to work well, our measurers being as a rule regarded with confidence both by architects and builders, and by such employers as know anything about them—and that no less with respect to general accuracy than to upright dealing between parties. Though the practice of ordination by the public authorities may appear somewhat antiquated, I believe it has a salutary effect both on the measurer and on his employers.* Nevertheless, there is room for improvement, and the establishment of more definite principles for general guidance could not fail to have a beneficial effect. The absurd system of including the measurer's fee with the builder's estimate is quite unworthy of any liberal

* Mr. Morham disclaims all intention of *urging* the general adoption of the custom of "ordination," as some of those present when the Paper was read appeared to suppose. It was only mentioned as a matter of fact, without which an account of the local practice would have been incomplete.

profession. Employers should be frankly informed that where foreknowledge and limitation of cost are of importance the measurer's assistance is indispensable, and his charges should be rendered in a separate account. The mere mode of paying fees may seem a trivial matter, and it may be said to be of little importance whether employers understand about it or not, provided they are not made to pay more than they ought. But, even allowing that hitherto no serious abuse has resulted, the practice is inconsistent with sound principles, and indications are not wanting, in some quarters, of an inclination to take advantage of the comparative security from observation to be found in the mazes of a schedule of Quantities, to slip in items which properly form no part of the builder's contract price; and I cannot refrain from deprecating the recent introduction into schedules of large items for copies of drawings furnished to the contractors, and for services connected with the clerk-of-works department. Such practices, I take leave to say, are a complete innovation in Edinburgh, and even if done with the employer's full knowledge, are unsound in principle, and fitted to lead to serious abuses. If done without the employer's knowledge, I refrain from giving them their proper name. Assuming, however, that it is the object of this Conference, not only to see that professional services are fairly allocated and adequately remunerated, but that all reasonable means are taken to eliminate practices and principles which may lead to unjust dealing, even though it could be shown that they have not hitherto resulted in that way, I conclude by wishing all success to the labours of the Conference.

(*d*) QUANTITIES: THE GLASGOW SYSTEM. By Mr. Robert Scott.

Mr. Chairman.—The mode of dealing with Quantities in Glasgow and the West of Scotland may, in contradistinction to all others, be denominated the after-measurement system. The surveyor or measurer, as he is locally designated, is usually employed by the architect on behalf of the proprietor or building owner. Parties proposing to build for the first time are not always aware of the existence of such a profession as that of measurer until informed of it by their architect, although it would seem that in recent years the general public must have been greatly enlightened in this respect, as not a few cases have occurred where the appointment of measurer has taken place before that of the architect.

The prevailing mode of procedure may be briefly stated as follows: the architect, having prepared his general and detail drawings, puts them into the hands of the measurer, along with a complete specification of the several works, or failing such specification, with such notes and verbal explanations as are necessary for enabling the measurer to interpret the drawings correctly, take out the Quantities of, and specify minutely the materials and labour required for, the execution and completion of the building according to the drawings. In the event of there being no detailed specification prepared by the architect, and such is frequently the case, the specification of materials and labour and the conditions of contract are either embodied in, or appended to, the "Schedule" or "Bill of Quantities." With reference to the measurement of the work after its execution, the conditions of contract usually contain the following or some similar clause, viz.:—"The work will be measured when finished, and whether more or less than now estimated, will be valued by the rates contained in this schedule or by others in strict accordance therewith, and in proportion to the sum in letter of offer." The "Tender" or "Letter of Offer" is affixed to the "Bill of Quantities," and is in the following or similar terms:—"—— hereby offer to execute the ———— Work of Building proposed to be erected ———— according to plans thereof by ———— Architect, now shown, in conformity with, and to the extent of, the annexed schedule, for the sum of ————." The acceptance of this offer by the architect on behalf of the building owner, in writing, usually constitutes the sole contract, as it is only in rare instances that a legal and formal deed of contract is entered into by the contracting parties. In making the after-measurement of the work, the measurer visits the building and takes his dimensions as often as may be necessary for obtaining access to and the proper examination of the work, and thereafter prepares the final measurements, all in accordance with the principles and spirit of the schedule, which is the basis of the contract. The measurer having completed the final measurement, it is handed to the contractor, who renders it to the architect by whom it is examined, and if found satisfactory, the architect grants a certificate for the balance found due, after deducting the total amount of certificates previously granted.

In bringing this system under the notice of this Conference of professional and practical gentlemen, I cannot hope that it shall receive consideration at your hands, unless it can be shown that it is equitable, suited to the requirements of building contracts, and conducive to amicable settlements.

This system of after-measurement is certainly the most equitable that could be adopted, as under it the

building owner pays exactly for what he receives, neither more nor less, and the contractor gets payment for every iota of work which he executes, and which he can reasonably claim; and it is no advantage for the contractor to scamp the work, as any saving that may be effected by so acting does not add to his profit, as might be the case under a lump-sum contract; while on the other hand the contractor runs no risk of being required to perform any work without due remuneration. In lump-sum contracts, where the tender has been made on a schedule prepared by a measurer, the contractor is the only party in a position to test the accuracy of the Quantities as measured from the drawings, the ordering of the material for the work being an unquestionable test; and it is but natural to suppose that he will detect omissions and insufficient Quantities more readily than excess in Quantities, as it is only the former that concern him. As an illustration of this, it was only this week that I had a visit from a contractor for plaster work, who does a large business under lump-sum contracts, and on my inquiring as to how he got on with such contracts, he replied that they were very unsatisfactory; it was invariably one of the conditions in the schedule that he had to satisfy himself as to the accuracy of the Quantities which it was generally impossible to do, previous to his tendering; but that he usually ordered one ton of lime shells for each hundred square yards or nine squares of work, and if this proportion of material was sufficient for the work he considered the Quantities stated in schedule sufficient, and he had often a quantity of material to remove after he was finished, although sometimes he required more material, and in that case he believed himself to have been victimized. I have had occasion to measure up the extras on a lump-sum contract, and my experience was, that while the contractor was very punctilious in pointing out and claiming extras, it was left for me to discover in what respects and to what extent the work specified and included in the schedule had not been executed, and I have no hesitation in stating that the measuring up of the whole work could have been done in about the same time, and would have given more satisfaction to all concerned. During this year I have been employed to measure up the extra underbuilding on a large contract, which is being executed for a lump-sum, and the ascertaining of the amount of extras entails the measuring of the whole work as executed, and of the contract drawings, and the comparison of the one with the other, which simply makes double labour.

Some have objected to this system because they say it is impossible, under it, for a building owner to count the cost before he begins to build; well, it has been demonstrated over and over again in the practice of Glasgow measurers, that a building owner can count the cost before he begins to build, provided he determines beforehand what he shall build and what it shall be built of. And it shall not be contended that an owner, building under a lump-sum contract, can know exactly what he is to pay until the building is completed, if he is continually changing his mind and making alterations on, and possibly additions to, his plans. From experience, I can state that, in cases where the plans have been generally adhered to, it is no unusual thing for the amount of the after-measurements to be within one or two per cent. of the contract sums; of course, I have also had them turning out much larger in amount than the contract, and very properly so, because the owner only discovered what he would like to have when the work was in process of execution, and altered and added to the work to suit his new and enlarged ideas; and in such cases occurring under a lump-sum contract, the preparation of the bill for extras would certainly be as laborious an undertaking as re-measuring the whole work. Besides enabling the building owner to count the cost before he begins to build, the schedule, being generally prepared in such a form that the work appears therein as nearly as possible in the order in which it will be executed, serves as a reliable guide to the architect in assessing the value of work executed, and to the contractor in calculating what he is entitled to be paid when the work has reached the several stages at which it has been arranged that payments shall be made. Further, this system of after-measurement is convenient in cases where it is necessary to proceed expeditiously with the erection of a building, as the Bills of Quantities can be prepared and contracts entered into so soon as the architect has completed his general drawings and decided generally on his details; as he can, during the progress of the work, study and complete his details without fear of being met with a demand for an extra, if he varies from a line by a hair's-breadth, as both he and the contractor know that it will be measured as executed and charged accordingly. Again, the whole work being measured as executed, the possibility of disputes about extras is reduced to a minimum, as there can be no difference of opinion as to what should be charged as extra, the only points to settle being as to the value to be put upon work executed, and for which prices cannot be found in, nor deduced from, the schedule, and such points likewise arise in connection with bills of extras on lump-sum contracts. The customary method of dealing with prices for extras is for the contractor to price them, and his prices are filled into the measurement in red ink to distinguish them from prices taken from the contract, and they are either passed or adjusted by the architect when the measurement is submitted to him for examination.

Out of over 1,100 contracts for which I prepared the schedules, I have had only one instance in which these

prices were not adjusted between the architect and contractor, and that, the instance under a lump-sum contract already referred to. Having thus briefly endeavoured to explain and uphold this system of after-measurement, I trust I have been able to put it in such a light as will commend it to your consideration in the discussion of this important subject of "Quantities," and I am hopeful that, in any future conference on this and kindred subjects, Glasgow will be represented by an abler exponent than myself of the practice prevailing there, and one appointed by the Glasgow Institute of Measurers.

J. A. PICTON, F.S.A., *Fellow*, said he had had in his time a great deal to do with Quantities, both as a taker-out of them in the early part of his professional career, and, in later years, as the architect of buildings for which Quantities had necessarily to be taken out by others. He had paid a great deal of attention to the subject, and would give, in as few words as possible, the conclusions at which he had arrived. The subject could be looked upon from two points of view: What is right in principle? What is practical? Looking at the question, firstly, in the light of right and justice to all parties, and assuming that proper skill and care were exercised in taking out the Quantities, and that there was good faith all round on the part of the parties to the work, he thought it would not be difficult to arrive at a satisfactory solution of the difficulties of the question: What was a Bill of Quantities? It was simply an admeasurement taken before a building work was done, just as a measurement bill was a measurement taken after the work was done. Now, if proper skill were exercised, it ought to be as easy to measure a building before it was erected as afterwards; and if that were so, it was difficult to see any reason why the Quantities should not form part and parcel of the contract, as something which could be relied upon by the builder and the building owner as a *datum* from which any alterations, additions, or omissions could be calculated satisfactorily. He could not see how any objection could fairly be taken to the adoption of such a course. Objection to it could only arise, as it seemed to him, from two causes—firstly, from greed, and secondly, from incapacity and a wish to avoid responsibility. He had known of cases—and the chairman in his remarks had made some reference to the pernicious practice—where the architect had shared the commission paid for Quantities. Under such circumstances, could it be wondered at that blunders should occur and that misunderstandings should arise? These were evils which arose from greed and incompetence combined. He had no objection, under certain circumstances, to the architect of a building—or some one in his office in whom he had perfect confidence, and who was responsible to him—taking out the Quantities for his buildings, although, all things considered, it was the better course, where possible, to have the Quantities taken out by an independent Quantity-surveyor. Still, it might not be a matter of much consequence by whom the Quantities were taken out, if they were acknowledged and accepted by all parties to the contract. With regard to the practice of the Office of Works in requiring builders to verify the Quantities upon which they tendered for public works, they might just as reasonably be required to take out the Quantities themselves. Under such a condition as that named in the advertizement read, of what possible benefit could the Quantities be to persons tendering? The imposition of such a condition seemed to be a very discreditable way of shirking responsibility on the part of a public department. Of course the Quantity-surveyor, like any other professional man, might properly be expected to bring a fair amount of capability to the performance of his work, but the best of men were not infallible, and it was quite possible for mistakes to occur even in the work of the most skilful and careful men. He would suggest that it might be a good practice to adopt if Quantity-surveyors would undertake to prepare Quantities for buildings at 1 or 1½ per cent. under the ordinary conditions—that is, "errors and omissions excepted"—exercising all possible care to ensure, but not guaranteeing, the accuracy of the Quantities; while they might, on the other hand, say, "Give us 2½ per cent., and we will guarantee the accuracy of the Quantities," the extra payment in the shape of commission being, in fact, a sort of insurance premium. That might seem to be a fanciful remedy, but it was only suggested as one possible means of surmounting a difficulty. With regard to the person who actually paid for the Quantities, he thought it would be the best for all parties if the business were conducted in a perfectly straightforward and above-board manner. If the employer or building owner were straightforwardly told at the outset that he would have to pay a commission for the preparation of Quantities, in addition to the architect's commission, and if the Quantities were made a part of the contract, a great deal of misunderstanding and disputation would be saved, and in the event of difficulties arising they would be much more easily settled than was now generally the case. The practice of making the Quantities part of the contract was a growing one in Liverpool and its neighbourhood, and he hoped to see its wider adoption. Under the present system of working there was too frequently manifested a "pull devil, pull baker" spirit between architect and Quantity-surveyor, each of whom sometimes tried to get the better of the other. There was one practice on the part of architects which could not be too much reprehended, viz., the throwing of much needless uncertainty as to the nature of the details of a

building on to the builder, by not delineating them on the drawings, whereby the builder was unable to realize the exact intention of the architect, and therefore was unable to calculate their cost. With regard to the Glasgow system of re-measuring work, it was no doubt a very excellent plan to adopt, but he (the speaker) was not sure whether it would meet with general acceptance. He thought employers might, in some instances, object to it, and would say, in effect, to the architect, "We expect you, as the architect, to inform us at the outset as to the exact cost of the building." The Glasgow system was, however, a very excellent one. On the whole, he did not think that there was any question of greater importance at the present time to the architectural world than that of the desirability of settling this question of Quantities on a right and just basis.

JOSEPH GODDARD, *Fellow*, President of the Leicestershire Society of Architects, said that the practice of his firm (Messrs. Goddard and Son) was to have the Quantities for their works taken out in their own office, they being responsible to the builders for their accuracy, but charging a somewhat higher commission than 1 or 1¼ per cent. for them. It had been the practice for his firm to take out their own Quantities ever since it had been necessary to put up works to competition, and they found that, as a rule, clients did not object to pay the cost of preparing Quantities when the necessity for doing so was explained to them. On the part of the Leicester Society of Architects, he promised to give all possible aid in the solution of the question.

J. L. RANDAL, *Fellow*, said that his practice in Shrewsbury was similar to that of Mr. Goddard at Leicester. He had always taken out his own Quantities, and it was necessary that provincial architects should do so.

PROFESSOR KERR, *Fellow*, said that there was a very marked contrast in principle, as well as in practice, between the Scotch mode of procedure and that followed in England; and he must say that, with all due love for his native land, he did not think that the Scotch method could be satisfactorily pursued in England. The late Thomas Carlyle had told us that England contained thirty millions of people, "mostly fools," while everybody knew that Scotland had a population of only four millions, with very few fools indeed. It should be remembered that the manners and customs of the two countries were different, and in view of this fact, it would, he thought, be unwise to suppose that in England, with its wider associations and more varying circumstances, we could advantageously confine ourselves to the peculiarly strict mode of doing business which was pursued in the North. He did not think that "ordained surveyors" would be a success in London. We had here, it was true, such beings as "chartered accountants," but he (the Professor) was inclined to thing they were officials of Scotch importation, and, indeed, of the same species as "ordained surveyors." The practical manner in which Mr. Picton had handled the subject was well worth imitation. By all means let it be taken for granted that there was honesty all round; why should it be supposed for one moment that there was anything else? He sincerely believed that half of the ill-feeling that had been engendered in reference to the subject had arisen out of the supposition—entirely gratuitous—that there prevailed on all sides a spirit of bad faith. His experience was entirely opposed to the reasonableness of such a supposition. When a client came into his office and wanted a building erected, he was frankly told that he would have to pay, besides the ordinary commission to the architect on the cost of the building, the commission to a surveyor for preparing the Quantities. He could not conceive of a case in which the client was uninformed of the fact that he would have to pay for Quantities. Supposing, then, that there was honesty all round to begin with, the architect's function was, in part, to see that such honesty was maintained. An architect might be said to be responsible to the builder for the honesty of the client, responsible to the client for the honesty of the builder, and it was to be hoped, he was responsible to both for his own honesty. Mr. Young's Paper, it seemed to him, proceeded too much upon the assumption that many architects were dishonest, but that Quantity-surveyors were always honest. With all deference, he did not think there was any ground for so broad an assumption. He saw one gentleman, a Quantity-surveyor, in that room, against whose integrity not one breath could be whispered; and he saw another, and another—and he had no doubt that of the majority of the members of the profession the same thing could be said; but, at the same time, there were men in the profession—as there were men in all professions—who were not to be trusted, and in discussing this question it should not be forgotten that the architect had in fact to be, to a certain extent, responsible to the client for the honesty of the Quantity-surveyor. A good practical architect would, therefore, take great pains to select a good surveyor, and to see personally that he did his work in a proper way; but if architects preferred to hand over their clients' interest to strangers, and expected to be freed from all further responsibility, he did not think it could be done, either in law or in practice.

T. M. RICKMAN, F.S.A., *Associate*, said that he had been, as they knew, a measuring-surveyor for a long period, and he found the position of measuring-surveyors changing from year to year. At the time these

discussions on Quantities were commenced, ten or twelve years ago, at the first of these Conferences, a certain amount of information which had been referred to by the Chairman had been gathered, but since then times had changed, and with the change of times Quantity-surveyors, and to a certain extent the nature of their work, had changed. With regard to builders, there were three classes of them with whom architects and Quantity-surveyors had to do. Firstly, there was a certain class of builders who would do their work well for whatever price they had agreed to do it. There was a second and a very large class of builders who would do their work well or indifferently according to whether they were well or ill paid for it; and there was a third class of builders who could not do their work well however they were paid. Where the client was first-rate, and where the architect, builder and surveyor did their work properly, matters would go on smoothly, especially when the Quantities were part of the contract. Casual errors could be easily detected and adjusted in the settlement of the accounts.

GEORGE FOWLER JONES, *Fellow*, said that at the outset of his career he was very much opposed to having anything to do with Quantities; but he soon found that it was necessary in the country, in order to get anything like proper estimates, to provide Quantities. Having been brought up in a London office, he procured from London a Quantity-surveyor, who prepared the Quantities for works submitted to competition, but the experiment did not answer, for the local builders did not know the surveyor, and therefore would not trust him. When he first commenced practice in York it was very difficult to get a whole tender for a building, the custom being to procure separate tenders for the different trades. He had tried the Scotch method of getting out approximate Quantities, so as to get at an approximate estimate of cost, measuring up the works when completed. That method saved a great deal of trouble in the matter of settling for omissions, alterations or additions; but there was the objection to it that the employer did not and could not know at the outset exactly what his building would cost. After a time he adopted the plan of having the Quantities prepared by a surveyor in his (the speaker's) own office, and under his own superintendence. He had always told his clients that there would be an extra charge for Quantities—some objected to paying more than the usual commission of 5 per cent., and they were informed that the builders usually paid for the Quantities, and that it was therefore added to the amount of their contract, if not paid direct by the employer. He had carried out that method of practice for the last twenty years, and had found it to work fairly well. He agreed in thinking that, as a rule, the quantities should be the basis of the contract, together with the drawings and specification.

Mr. FRANCIS TURNER said that, with regard to the Quantity-surveyor's position and the work which he had to do, it was quite true that the recognized legal position of the Quantity-surveyor started from the case which Mr. Young had described as "the Quantity-surveyor's sheet anchor," in which case the Quantity-surveyor established the liability of the building owner to pay him for work which he had done. It might seem rather startling that an action was necessary to establish such liability, for if the building owner desired to be correctly informed of the cost of the work, and with that view caused to be employed a Quantity-surveyor, the presumption would rather be that the building owner and not the builder was liable to pay him. That case was, he thought, decided in 1833, but before that, the custom as now established and recognized by that particular case, must have grown up, and the Quantity-surveyor must have looked to the builder as the person from whom, under ordinary circumstances, he was to receive his remuneration, and from whom he did actually receive his remuneration whenever a contract was entered into. The circumstances under which that case came into Court, were that before a contract had been entered into, but after the Bill of Quantities had been prepared, the building owner changed his mind, and then unsuccessfully contended that he was not liable to pay anything for the work which his vacillation had made useless. But although the decision in that case had been pretty freely acted upon, it nevertheless happened that in a case very recently tried at the Guildhall, a building owner, who was sued by a Quantity-surveyor, professed to have heard nothing of the custom of preparing Quantities for a building. The judge and jury were against him, however. The case to which reference had been made had had some unexpected results upon the position of the different parties interested in building operations, because, from the fact that when a contract had been entered into, the builder was the person who had to pay the Quantity-surveyor, it seemed to follow logically that the builder was the only person who could complain of the Quantity-surveyor not doing his work properly. He did not think that many professional men would like to work under such liability to serious consequences at the hands of people upon whom, to a certain extent they were dependent. The position of a Quantity-surveyor did seem to be, in some respects, open to grave objection, especially when he happened to be also the architect of the building for which he prepared the Quantities. He (the speaker) had so frequently had the pleasure of coming into contact with members of the architectural profession, and had invariably had so much reason to admire their

rectitude and ability, that, in adverting to the objections to the relations which sometimes subsisted between architects, Quantity-surveyors and builders, he should not be misunderstood as making any imputation upon the body of the members of the profession, if he pointed out that the architect who acted as Quantity-surveyor to his own buildings, and who was paid by the builder for preparing the Quantities, laid himself open to the chance of being suspected of not being altogether impartial in his judicial decisions as between builder and building-owner. It seemed to be a hard thing to say that an architect ought not to be allowed to take out Quantities, seeing that, in the architectural as in the legal profession, the early years of practice were the most difficult to tide over, but the expediency of separating the two professions of Quantity-surveyor and architect was well worthy of consideration. With regard to Professor Kerr's observations, he was somewhat at a loss to understand them. If the English were such a benighted nation as was stated by Carlyle, it was really very kind of so many of their Scotch friends to come and dwell amongst them. Notwithstanding, he did think that the practice which prevailed in Scotland of making the Quantities part of the contract was the simplest and fairest to all parties. It gave to the builder payment for all that he did—it bound the building owner only to pay for what was done, and it did not seem to involve any reflection upon the architect, nor place any temptation upon the Quantity-surveyor to be loose in his dealings.

Mr. STANLEY G. BIRD, President of the National Association of Master Builders of Great Britain, said that the question of making the Quantities part of the contract was a matter which had exercised the minds of the master builders for a very long time, and he need not say that it was a matter of vital importance to them, as they were frequently great sufferers in consequence of the Quantities being taken out badly. The master builders, he might say, had now arrived at a form of contract which was very nearly like that which was agreed upon between them and the Royal Institute of British Architects some years ago, the only difference being that, in the new form of contract, the Bills of Quantities were made a part of the contract. He spoke from experience when he said that in the provinces, where there were no professed Quantity-surveyors, builders were very frequently obliged to accept Quantities which, to say the least, were curiosities.

JOHN HONEYMAN, President of the Glasgow Institute of Architects, *Member of Council*, said that he, like Mr. Turner, had been unable to understand Professor Kerr's objections to the Scotch method as being far too good for adoption in this country, He could only say that the Scotch architects were guided by two principles which seemed to meet with considerable acceptance in England, and which probably might form the basis of a substantial agreement leading to some uniformity of practice throughout the country. The first was the principle that the building owner should really be the employer of the surveyor and pay the surveyor. The other principle was that the Bills of Quantities should be the basis of the contract. Those were principles which were fully acted upon in Scotland, and if they were generally recognized, he could not but think that they would lead to further reforms. One substantial result of their adoption in Glasgow was that practically no law cases connected with building contracts ever occurred, as had already been mentioned by Mr. Scott. In his (the speaker's) own practice, he had not known a single law case arising out of any contract with which he had had anything to do. He thought it would help to bring British architects into accord, and would give the deliberations of the Conference an important practical result, if on both those points the meeting could arrive at some agreement.

Conference Third Meeting.

QUANTITIES: THE IMPORTANCE, AND ADVANTAGE TO THE CLIENT, OF QUANTITIES AND MEASURING OF WORKS BEING DONE BY THE ARCHITECT OF THE WORKS, OR UNDER HIS IMMEDIATE SUPERINTENDENCE. By Mr. MEDLAND TAYLOR.

[Tuesday Morning, 10th May, 1881, Arthur Cates, *Member of Council*, in the Chair.]

Mr. Chairman.—It has always seemed to me a mistake to treat quantity-taking, and the measuring of artificers' works, as something apart from, or outside of, the ordinary business of an architect's office. In turning to the Address of my distinguished predecessor, in the office of President of the Manchester Society of Architects, I find Mr. Waterhouse saying:—"It is this sense of the duties of our profession towards our clients, in this difficult question, which has

always induced me to believe that the rightest plan was for the architect to have the quantity-taking of his own works as much as possible under his own control, and when this was impossible, to employ men of the highest integrity and position."* In the Annual Report of our Society for 1878, we have given our deliberate opinion in words which I beg leave to repeat, namely :—

"In these days, owing to the almost universal prevalence of competition, it is of course next to impossible to get tenders from builders unless the Quantities be supplied to them. The question therefore, of the taking-out of Quantities, is thrown almost always on the consideration of the architect, and it is left to him to decide how this work can be best accomplished in the interest of his client. Now your Council generally is of opinion that an architect can probably best secure this result by taking out the Quantities himself, that is to say, in his own office and under his own supervision."

Some years ago our Society framed and issued a set of rules for the guidance of those occupied in the taking-out of Quantities and measuring up works—one main point being so to regulate the work that all such bills should represent accurately the actual quantity of material and labour required in a building, and that such questions as "allowance" and "waste" should be left wholly to the judgment of the estimating builder. We have good reason to believe that these rules have, at least in the Lancashire district, been extensively useful in obtaining fair and just estimates, and in avoiding disputes in settlements. Not only is an architect responsible to his client for the design of his building and for the proper execution of the work, but a client will also tell you that he considers his architect equally responsible for a due control of the outlay. For seeing to it: that the tender offered for acceptance is fair and moderate in amount, and that at the end a fair price is allowed for any omissions, and that any extras are charged at a rate not greater than that of the bulk of the work. And we, as architects, must admit that our clients have a right to expect of us a guardianship of their purses of this sort and to this extent. I venture to maintain that an architect who does not, himself, at least control, regulate and supervize the Quantities, and measure bills relating to the works carried out by him, leaves one end—or say a corner—of his employer's purse not duly guarded. We have to remember that, whatever we may draw or specify, it is the Bill of Quantities, as priced by the builder, that really and in fact has most to do with settling the cost of any building. A contractor who had once carefully priced out his estimate from a Bill of Quantities would not easily be persuaded to reduce to any great extent the total estimate afterwards. I wish here to say that no disrespect to, or imputation against, those who make quantity-taking a distinct and special profession is intended. Every architect in large practice must feel what a great relief it would be to have no trouble or anxiety about Quantities,

* In this Address to the Manchester Society, delivered in 1878, a serious error, which has been subsequently repeated in other similar Addresses at Leeds and elsewhere, occurs. Mr. Waterhouse therein, continuing the sentence quoted above, expressed his regret at "the action of the London Institute in forbidding its members to act in the capacity of surveyors to others of larger practice than their own, for what employment," said he, "would be more remunerative or instructive to the young architect, with at times little to do on his own account, than, if properly qualified, to take off the Quantities of the designs of others?" No such restriction exists as regards the majority of members. On the contrary, the Associates of the Royal Institute of British Architects are, and have always been, permitted to act as Quantity-surveyors for other architects. In fact, some of the most respected Quantity-surveyors are Associates of the Institute. The declaration of an Associate, in this respect, is: "*I will not take out the Quantities for works to be executed under my own superintendence, except with the concurrence of my client.*" A Fellow, only, is prevented by the declaration he makes from taking out Quantities for works other than those executed under his own superintendence.—*THE SECRETARIES: R.I.B.A.*

estimates, measures, bills, extras and deductions, but to leave all such matters to an independent person—if only this could be done with a due regard to the interests of one's employer. I think it cannot. In the case of Quantities, however full and complete the detail drawings, they cannot, nor are they intended to show the exact amount (neither less nor more) requisite to make "a good job" in all the various items which a builder has to price. No one so well as the architect should be able to tell exactly what will do—neither too much, which is waste, nor too little, which may be dangerous or mean. The architect's judgment is tempered and corrected, not only by a strong sense of what is due from him to his client, but by the recollection that if the Quantities are excessive in measurement or in description (which is as important as measurement) the estimates will be correspondingly excessive, and the drawings may have to be re-made, if indeed the client does not get so disgusted at the tenders as to stop the work. On the other hand if the Quantities are deficient, and do not provide enough to carry out the work shown on the drawings and specified, the credit attaching to a really good building, well carried out in every detail, may be altogether cast in the shade and lost by an unpleasant final reckoning with the builder, or with the client, or with both. Besides his sense of duty, therefore, an architect has strong personal interests in both directions. He has as much to fear in the quantities being deficient as in their being in excess, and thus is helped to keep a just balance. An independent Quantity-surveyor, on the other hand, has much to fear if Quantities be deficient. But who is there to complain if they be in excess? That is, the pressure is all, or very nearly all, on one side and against the client. The custom of letting every measurement be "enough" or "full," as it is called, and of making the "allowances" for waste and otherwise, expected by the trade, all tend to keep the estimates up. In those few cases where the competing builders all know the exact mode of the Quantity-surveyor, and of the view taken of his Bills by one another, the tendering may be fair enough, but hardly otherwise. When Quantities represent with accuracy the amount of work and the amount and quality of labour that will be exacted by the architect in the building, then and then only can tenders be reliably fair as towards clients on the one side, and just to builders on the other. That this result can be attained, as a rule, when Quantities are taken out by a person, however skilled and experienced, working independently of the architect's direction and control and mainly for the builders, it is difficult to believe. Nearly a quarter of a century ago, when working in London, I do not remember one case in which, when Quantities were taken outside the office, tenders were not greatly in excess of the office estimate, although as a rule work was usually done in the end for a sum varying but little, if at all, from the architect's previous notion of what it should be. I feel confident that those architects who have pursued both plans, will admit that usually when Quantities have been taken out by themselves, or under their own immediate supervision, the tenders will be moderate, and they can form a pretty accurate judgment of what the amounts will be. Whilst if an independent, and especially if a strange, surveyor is employed, the estimates are pretty sure to be high and perhaps wide also. My argument therefore is, that the mode of dealing with Quantities now urged is not only greatly for the advantage of our clients, but is more just to competing builders. When the case is that of measuring-up work, whether it be an entire building done by schedule of prices and measured-up afterwards, or the measuring-up of extras and omissions of a building for which there has been a lump-sum contract, I hold quite as strongly that it is the architect's

duty to see to it. It has not been my fortune to meet with any Lancashire man of business to whom I should have ventured to submit a final account certifying that such and such a balance was in the opinion of Mr. Le Gros, the measuring surveyor, due to Mr. Plane the builder. Nor do I think it right for an architect (who should be as much a man of business as an artist, and unless a man of business brilliant artistic powers may prove unmarketable talents) thus to shirk his responsibilities and to risk more or less the pecuniary interests of his employer. An architect who personally and frequently inspects the buildings in progress under his care, is usually the only man who really knows all the facts and considerations which should determine exactly what and how much ought to be allowed to a builder, and what deducted from him. A measuring surveyor gives way to a builder's pressure and importunity, not from improper motives, but because he is not and cannot be, in most cases, duly informed as to the weight and strength of arguments and facts on the other side; besides, as a clever lawyer's clerk can make out a bill of costs that one knows to be excessive and yet cannot be reduced on taxation, so an able measuring surveyor can unquestionably make out an unassailable bill of extras which yet may be very unjust to the proprietor and client. How can such delicate and onerous duties be delegated to one more or less—if not as in some cases entirely—independent of the architect's authority and control, without danger, I should say a certainty, of sacrificing the interests of the client? Again, if an architect is to administer a contract effectively he must have supreme control over money matters, or where is his power? The two separate points of the due execution of any work, and the amount to be paid for it, seem to me so bound up together, that the responsibility for and superintendence of both must rest with the same person. Numerous cases, illustrating the position I have taken, are probably within the recollection of all around me; if I described some of those that occur to me I feel that they would strengthen my arguments, but at the expense of not keeping my promise of a very short Paper. I hope that it will not be thought that I have been dogmatic. I confess I feel very strongly indeed that no work within an architect's province has to do more directly with the interests of his client's pocket than that of this department of taking out Quantities and measuring up work. I think every opportunity should be taken of making it clear to the public that the work in question is necessary and honourable, and that an architect who gives close attention to this matter is doing his clients not the least important of the numerous services which it is his duty to render.

THE CHAIRMAN said that, as the builders were desirous of their views being submitted to the meeting, he would ask the Honorary Secretary of the Institute to read extracts from a Paper by Mr. Edward Hughes, of Liverpool, read last year, before the National Association of Master Builders of Great Britain.

The following extracts from Mr. Hughes's Paper, entitled *Bills of Quantities and Measuring Builders' Work*, were then communicated to the meeting, namely:—

"I will endeavour to put into shape in as practical a form as possible, and in the plainest language, my experience and views on this subject. In doing so, if I should say anything that may appear to reflect upon the character or work of any architect or surveyor, or of any class of them, I am sure all will acquit me of the intention of saying one word of disparagement of any architect or surveyor who is worthy of the name. . . . A 'Bill of Quantities' is a detailed account of the quantity, quality and description of every portion of the work required to be done in the execution of any building, for which the person wishing to build requires to know the cost, before embarking in any engagement or contract with a builder to execute the proposed work. Without a 'Bill of Quantities' it is impracticable, in the case of works of any importance, to obtain by

competition estimates or tenders for work, and it is obvious that such competition is obtained entirely in the interests of the proprietor about to build. . . . Who prepares the 'Bill of Quantities'? Sometimes the Quantities are prepared by the architect himself, or by his assistants in his name. In such cases this is done either with the sanction of his client or on his own appointment and responsibility, but the builders have no voice in such appointments. In other cases the Quantities are prepared by a surveyor appointed by the architect or his client. Occasionally two surveyors are appointed—one by the architect on behalf of and in the special interest of his client, and the other by election of the majority of the builders competing."

"I know of only one line of argument in favour of an architect acting as his own Quantity-surveyor, namely, that no other person can know so well as himself what are his requirements, as shown and described by his plans and specifications, nor is any other person so likely to know what changes take place requiring measurement as the work progresses. At first sight to a novice this argument appears plausible, and, with a first-class architect of large experience, it may be made to work tolerably well; but, on the other hand, there are numerous reasons against the plan, such as—(*a*) The architect, as a rule, looks upon himself as the servant of his client only, and in many cases he is restricted by his client to a limit in regard to the cost of the proposed buildings. This is especially the case in connection with works in which architects have themselves competed; also in cases where the architect is young in the profession, and more subject to the influence that may be brought to bear upon him by his client. (*b*) An architect who occasionally takes off his own Quantities cannot possess the experience or the facilities and special knowledge for such work as a surveyor who devotes his whole time to it, and who has been especially trained for the work, is able to do. (*c*) An architect in good practice has the usual daily routine of duties to attend to, which will necessarily prevent him giving the sole and undivided attention which is absolutely necessary while the process of abstracting Quantities is proceeding, otherwise errors of a more or less serious character are sure to occur; nor can a measurer's duty be properly delegated to assistants any more than can the heavy responsible duties of eminent physicians or lawyers be delegated to unqualified clerks. (*d*) In the event of errors being discovered in the Quantities supplied by the architect himself, he is at once placed in a false position. It must be most difficult for him, under such circumstances, to hold the balance fairly and equitably between himself and the builder on the one hand, and between the builder and the owner on the other; no matter how honest he may be, or desirous of doing what is equitable towards the builder, he cannot, in the very nature of things, avoid being biassed in a measure against the builder in the proprietor's favour, when the opposite course would expose his own errors of Quantities and thereby prejudice his client against himself."

"Who should be responsible for the accuracy of the Quantities? In reference to the only two parties to a contract: should it be the proprietor or the builder?

"I have already shown that the proprietor, either directly or indirectly, through his architect, almost invariably appoints the surveyor, to supply the builder a list of the quantity of the various work he desires a quotation for in competition. When he accepts a tender he undertakes to pay the builder the stipulated price for the quantity of work mentioned in his application, neither more nor less. If, therefore, the quantity given proves to be deficient or in excess, it is obviously just and right he should pay the builder less or more, according to the work actually done. Otherwise, in the case of excess of work done, he obtains that excess without honestly paying for it (taking advantage of the incapability or negligence of his own appointed surveyor). If, on the contrary, there be less work done, then the builder gets paid for work he has not done. During the progress of building, each party, under these circumstances, has a strong inducement before him to take advantage, the one of the other: the builder to omit some and scamp other work; while the proprietor (or his agent) may try all he can to take advantage of clauses in his contract giving him almost absolute powers to impose work on the builder that is not mentioned in the Quantities furnished to him, and may refuse to pay for such work. I think I may venture to assert that, in no other trade than that of a builder and contractor, does such a state of things exist as this, that a tradesman or merchant should be called upon to supply more goods than are bargained for at a given price without extra payment. For example, if a builder asks a timber merchant to quote a price for 20,000 cubic feet of timber, for a particular job, and the offer be accepted, and 21,000 feet be supplied, no builder would be knave or fool enough to expect the merchant to forego his claim for the extra 1,000 feet. The same argument will apply to all materials, and labour also. . . . I submit, then, taking all in all, it is to the best interests of all parties—proprietor, architect and builder—that in every building contract a genuine 'Bill of Quantities' should be prepared by a properly qualified surveyor, at the expense of the proprietor, and guaranteed by him. This course would inspire confidence in the mind of the builder, and induce him to enter more eagerly into competition, having no fear of being misled by incorrect Quantities, and having no necessity to contemplate risk and add any sum to cover errors. The proprietor would

have the advantage of better competition, and generally would obtain better work and more fair dealing from the builder, who would have no interest in omitting or scamping his work, knowing that he would be paid for the work done, and no more. The architect would avoid any unpleasant discussions and disputes during the progress of the work, and after its completion."

"I met with a recent case where an architect had succeeded in obtaining by competition the commission for an important public building, with an elaborate tower as part of the structure, built with dressed stone, the work being what may be discribed as of a 'monumental' character. The Quantities gave this work as so many cubic feet of stone, including all labour of every description, this phrase being on the heading and not with the quantity. The result of separate tenders for the upper part of this tower was that they varied very much, from about 500*l.* to 1,700*l.* The lowest tenders were undoubtedly priced as stone and setting only, omitting all labour. I have before me Quantities for a public building, for which the architect's charges are two per cent., wherein he describes so many 'superficial feet of moulded-both-sides-swing-doors, hung folding, including ¼-inch polished plate-glass upper panels, protected by six wrought-iron bars, and patent swing-hinges to stand open.' No size of glass, no size or quality of bars, and no size or quality of hinges mentioned ! In many other items he gives superficial feet of doors, including best mortise locks and rebated and moulded frames, and neither number of doors, quantity or size of frames, nor number, size or quality of locks. You all know that, in the matter of locks, 'best' is a wide term. It means anything from 7s. 6d. to 75s. In one door he gives superficial feet of door, including 4-inch best butts, 5 by 4 rebated and beaded frame, two barrel-bolts, strong chain, drop-latch, lock (value 13s. P.C.), and approved bell-pull. Another item is—'Provide and fix cistern on strong bearers, and form trap-door,' without dimensions or particulars of any kind. In many items of this architect's Quantities, in addition to jumbling up doors, locks, hinges, bolts, &c., by the foot, he hangs on the words—'including painting.' This is notwithstanding the fact that there is a separate bill for painting. Great numbers of items of importance are given by this architect as lineal measure with no sizes. Some items are described as 'fixed,' while others have added to them the words 'including fixing.' In the former case the builder cannot tell whether the item is to include materials or not. Another specimen is—'Superficial feet of plain 1-inch boards (see plan).' The last two bracketed words convince the builder that quite the opposite of plain is meant : but he is to be paid plain price. I cannot for one moment believe that the architect who has issued these Quantities has personally had any hand in them, but they are in his name and he is to receive the fees, although they have most probably been taken by some unqualified person who has succeeded in obtaining a place in his office."

"I have known, in one church contract, the surveyor omitting to add up an item of 10,000 feet, being the left-hand figure of a five-figured item in his abstract for stone facings. He also omitted the whole of the dressed stone, sills, jambs and arches to the inside of all doors and windows ; the whole of the brick lining to the church, and gutters and down-pipes of one side of the church, besides others items, amounting in all to the value of 3,000*l.* to 4,000*l.* This work was done by the builder without obtaining one shilling in payment !"

"I have seen, in another schedule for competition, a number of ornamental wrought-iron grilles or panels for doors, described simply by number, to 'details to be subsequently supplied.' It is impossible to approach the value of such work from such description ; each grille might be worth any sum from 10s. to 10*l.*"

"In another case, an architect who was his own surveyor, required a wrought-iron cresting on the top capping of some gates to the back yard of a house, and described it by the running foot, without the height being mentioned or a drawing of any kind to show the character of the work. The builder priced work at 1s. 6d. per foot, or 15s. for a 10-feet gate. After the contract was settled the architect furnished a detail that would cost 30s. per foot, or about three times the value of the gate itself. More than this : he claimed the right to order two additional gates and crestings to be supplied at the same contract prices."

J. L. RANDAL, *Fellow*, said that when he was an articled pupil they were accustomed, as architects and surveyors, to take out their Quantities in the office, and all the pupils were as thoroughly instructed in Quantities and measuring, as they were in drawing and other more strictly architectural work. For some years after his pupilage he acted as managing clerk to a London firm, and in those days Quantity-surveyors were very few and far between. There were not more than half a dozen of them, of whom he recollected such men as Hunt, Tyerman, Corderoy, and others. In those days he had taken out Quantities against such men, for Quantities were then taken out by the architect, or under his direction, and supplied to the builder. In course of years, circumstances took him to Shrewsbury ; he there found that the practice of a provincial architect was very different to that of a London architect. After some years he managed, by much exertion, to bring together a moderate practice, but he found it an essential condition of pursuing that practice that he should take out his

own Quantities. His practice had been to do so for many years past, and indeed so long as he could afford to work at his profession he should take out his own Quantities, and he hoped that the Institute would do nothing to debar him, as a Fellow, from continuing the practice. If any restriction were imposed preventing provincial Fellows from taking out their own Quantities, he should have no alternative but to cease to be a member, for he could well afford to save four guineas a year and earn two hundred. For the last ten or twelve years he had always attached a priced Bill of Quantities to the contract, and it formed part of the contract. If he should unfortunately make an error in these Quantities he felt himself bound to make good. He thought that there was not necessarily anything in the practice of an architect taking out his own Quantities which bound him to be paid by the builder. Many of his private clients always paid him for the Quantities, and he could not understand why an architect, trusted with his client's interests, and empowered to act as arbitrator between client and builder, was not to be trusted with regard to the Quantities. Was he not, because that trust was reposed in him, to be paid for the work which he had done in taking out the Quantities? With regard to the extracts which Mr. Anderson had read, they only showed that the term "architect" was a very wide one. In his experience he had known of men who sought such appointments as that of county surveyor on the strength of having once been bricklayers. One reason why the architect of a building should be allowed to take out the Quantities for that building was that nobody was so qualified as himself to do the work, and, moreover, when an architect had prepared his own Bill of Quantities, he found it a comparatively easy matter to settle up "extras and omissions." With regard to what had been said as to the incomplete and misleading character of the Quantities supplied by some architects, was it to be assumed that on that account an architect, properly qualified to do so, was not to be permitted to take out the Quantities for his own work? Surely not. There were quacks in the world, but physicians ought not to be blamed because there were unqualified men who professed to be this, that, and the other. Why should he, as an architect, be under a ban because abuses took place? He considered himself, as an architect, a professional man whose function it was to act fairly between client and builder, never leaning more to one side than to the other. He thought he was a fair representative of provincial architects when he said that it was an absolute essential to the proper conduct of their business, and even of its conduct at all, that they should be permitted to take out their Quantities. Architects in good practice in London might be able to afford to discard the work of Quantity-surveying, but provincial architects could not do so.

CHARLES FOWLER, *Fellow*, said he thought that the side of the question, which had been taken by the last speaker, had been so very ably put before the meeting that it did not need much further illustration. It was, he thought, generally admitted that, in the practice of a country architect, it was a much more desirable course for the practitioner to take out his own Quantities, at any rate it was much less objectionable, than was the case in London. One reason why it appeared to be undesirable that architects in London should take out their own Quantities was that probably most of them during their term of pupilage had not been able, especially if brought up in London offices, to give any considerable attention to that branch of the profession; and unless they particularly wished to follow it out afterwards, they did not learn it thoroughly. It should be remembered that in these days the tendency was towards sub-division of labour—specialism; that was to be seen in the medical profession as well as in the profession of the architect. In the latter profession there was the Quantity-surveyor, who devoted himself specially to prepare Quantities and measure up; there was the architect who devoted himself more particularly to one style or group of styles; and there was the architect who followed no particular style at all, who built warehouses and large structures, in which construction was of more importance than art. These were all separate, though not strictly separated, branches of the profession. The consequence was that the Quantity-surveyor in London had become a much more separate, and necessarily more important, person than in the country, and that was one reason why, in London, Quantities were generally taken out by some other person than the architect; and he thought that was a reason why the London architect should not take out his Quantities. True, if the architect were thoroughly able to do it, no one could possibly take out the Quantities more accurately than he, knowing, as he did, all the ins and outs of the building; but whether it would be desirable was another question. As to making the Quantities part of the contract, he might observe that Sir William Tite, who was eminently a practical man, adopted the custom, in all large works, of making Bills of Quantities part of the contract. No doubt he had special reasons for that, resulting from his large practice, but he (the speaker) confessed that he had never been able to see his way to do so, and he could not help thinking that, if the practice were made general, it would tend to induce a careless manner of taking out the Quantities. On the whole, he thought that, in London at any rate, the ordinary course of entering into a lump-sum contract appeared to him to be the best, if carried out in a proper way, and upon a Bill of Quantities carefully taken out.

THOMAS MITCHELL, *Fellow*, said that Mr. Fowler's remarks seemed merely to indicate that a man who was incompetent to do work ought not to do it. It was perfectly immaterial who prepared the Quantities so long as they were fairly accurate. As an architect practising at Oldham, he might say that he had adopted the practice of having the Quantities prepared in his own office, though by an independent surveyor; but in all cases he found it advisable to give the contractor an opportunity of checking the Quantities, and he then made these Quantities the basis of the contract. On completion of the work, a statement of additions and deductions was prepared and priced out by the contract schedule, so that the proprietor paid for the work executed, and the contractor received whatever he was entitled to. He had pursued that course for a number of years, and he had found it very satisfactory in its results.

JOHN HONEYMAN, President of the Glasgow Institute of Architects, *Member of Council*, wished to correct an erroneous idea that the Quantities prepared in Glasgow gave merely an approximate estimate of the cost. They professed to show the exact cost, and they generally did so, and the actual cost of a building as executed rarely exceeded the amount of the original estimate, if the architect had properly prepared his plans and specification. In his own practice he had found that the variation from the tender was very slight, and as often resulted in a deduction from, as an addition to, the original sum. He was perfectly sensible that the direct bound from the ordinary practice in England to the adoption of the Glasgow practice was not one likely to be made, but he thought that, if the principle were generally admitted that the Bill of Quantities should form the basis of the contract, the ultimate conclusion must necessarily be the general adoption of the Glasgow system of measurement. With regard to the taking-out of Quantities by architects, there was no temptation for them to do so in Glasgow, and it was never done. There existed there a large body of excellent surveyors, who were constantly employed on behalf of the employer or building owner to do that kind of work, under the supervision of the architects. It was, however, he feared, impossible, in many parts of the country, to avoid this combination of architect and Quantity-surveyor, and therefore it was of the more importance that the principle of making the Bill of Quantities the basis of the contract should be fully recognized, because otherwise the architect who took out his own Quantities would be placed in a very invidious position. He was fully persuaded that the great body of his professional brethren were above suspicion, but it should be remembered that the strength of a chain was only that of its weakest link, and any particular course of practice which might be thought desirable for general adoption, while adapted to the conditions of the practice of the most honourable men, must be so devized as to guard the clients against dishonourable practitioners. Such safeguards would not be felt to be burdensome by those practitioners who were bent on honourable courses.

G. T. HINE, *Fellow*, said it appeared to him that there were before the meeting two distinct questions: One, were Quantities to be made the basis of the contract? and the other, by whom were the Quantities to be prepared? If they were to be made part or basis of the contract, he thought that the architect of the building, or the surveyor under his immediate supervision, was the proper man to take them out. If they were not to be the basis of the contract, then he thought the less the architect had to do with the Quantities the better. With regard to the first question, he had always failed to see how the proprietor could be justly served if the Quantities were not included in the contract. As to the architect preparing his own Quantities, he believed—and he spoke from experience, having until within the last three or four years prepared at least one Bill of Quantities every two months—that the architect who was able to do so was able to serve his client's interest in the very best way. He had the drawings before him, and before the building was actually built he himself had to build it inch by inch, brick by brick, in his mind, and as he proceeded with the work he was able to discover points of construction on which he could improve, and often with the most economical results as regarded his client. These advantages were not otherwise attainable. He believed that, for the young men of the profession, the taking-out of the Quantities of their buildings was the very best practical education they could have, and he would recommend that all young men who wished to be practical architects should begin their education in an office, either in the country or in London, where the Quantities of the works designed in the office were taken out. In his office the practice of making the Bill of Quantities and the specification one document had been adopted, and it answered very well. Every item in the Bill of Quantities had its specification, and it was evident at a glance what work had to be done, and in what position of the building each item had to be placed. By that means, as the work progressed, it could be seen at a glance by anyone, the proprietor as well as the architect, what had been put into the building. It had been remarked, in the course of the discussion, that errors in the Bills of Quantities arose from the fact that architects supplied deficient or insufficient drawings to the Quantity-surveyor, and that if the architect were to take out his own Quantities it would be utterly impossible for the drawings to be insufficient. In taking off Quantities he, as a rule, prepared his details as he proceeded.

J. TAVENOR PERRY, *Associate*, said that he was a London architect who did take out his own Quantities, but he could not class himself in either of the categories named by Mr. Young. He was not unable to take out his own Quantities, neither was he so busy that he could not afford time to do it. Any architect taking out his own Quantities was able to give attention to the drawings and specifications, and was better able to superintend his works in their execution, and with the result of securing greater economy, than when the accounts were left to be settled by reference to the measuring-surveyor. In reference to the examination of his drawings, if the architect did his work properly, he would have to spend almost as much time in going through his specifications as he would have to spend in taking off the dimensions, and he would venture to say that the architect who took off his own Quantities in a proper way, direct from the drawings, saved his client at least ten per cent. Everybody knew that it was impossible, in a building of any size, to avoid variations, however carefully the drawings were made, either from the new wants of the client, or from the new ideas of the architect; but where variations or extras had occurred, the architect who had taken off his own Quantities was able very greatly to facilitate the measuring-up of extras and omissions. He (the speaker) always supplied the builder with a copy of the dimensions if it were asked for, or he allowed the builder's clerk to come to his office and copy it. He made his Quantities a part of the contract, and accepted the responsibility of them. He might add that he never took out the Quantities for a building without explaining the whole matter to his client, and he seldom met with any difficulty or objection. Indeed, in some very large works recently carried out by him in London, he was expressly requested by the promoters to take out the Quantities.

Mr. JOHN McLACHLAN, President of the Edinburgh Architectural Society, said that the general consensus of opinion, so far as he could gather it, seemed to be that the Scotch system was a good, and probably the best, system. The position, so ably supported by Mr. Medland Taylor in his Paper, that the architect should take out his own Quantities, was one which was apparently justified by existing circumstances in England. Mr. Taylor urged that the architect, knowing as he did all about his own design, could much better take out the Quantities for it than anyone else; but he thought that Mr. Taylor, if he could have recourse to the services of such men as comprized the class of skilled surveyors in Edinburgh—men who were perfectly acquainted with building construction, and able to rightly interpret the architect's intentions—would probably somewhat modify his opinion. It seemed to him (the speaker) that the most fatal objection against muddling up together the architect and surveyor was that such a practice placed the architect in a most invidious position, and he thought it should be the object of the Royal Institute of British Architects to insure that the conduct of professional practice was as high and as honourable as possible. Architects ought to purge themselves of anything and everything which might be thought to unduly influence them, in the discharge of their duties, either towards the client or the builder. He thought that if architects prepared the Quantities for their own buildings, disputes would continually arise between them and the builders, and the constant squabbling and bickering, in which the architect would find himself involved, would not add to his professional dignity. All such squabbles between architect and builder would be unknown wherever, as in Edinburgh, they had a class of skilled surveyors acting between architects and builders. The Edinburgh system was, he contended, fair in its operation towards all parties.

HAMPDEN W. PRATT, *Associate*, said that since he had commenced practice he had determined to have nothing to do with Quantities himself, because he thought that was the better course to pursue. Several reasons had been assigned why it was not advisable that the Quantities should be taken out by a surveyor, but one reason why architects would and did take them out was that their commission might by this means be increased. He really thought that the best man to deal with Quantities was a competent Quantity-surveyor—a man who was able to give his whole time to that sort of work. He believed that if three out of every four builders were to be asked which they would sooner tender under, architects' or surveyors' Quantities, they would reply "surveyors'." But they were not looking at the matter entirely from a builder's point of view, although builders were worthy of consideration in the matter. For his own part, he believed that an architect was quite as capable as a surveyor of taking out Quantities in excess. It was only reasonable that the builder should have a fair profit on his work; but whether the builder made a gain or sustained a loss on a job he thought it was not right that his gain or loss should have arisen out of the excess or deficiency of the Quantities, prepared by the architect under whom the work was carried out. If the architect made a mistake on the side of the builder in preparing the Quantities, the client suffered, although he heard nothing about it; while if the mistake were against the builder, the architect, not liking to go before his client and acknowledge his mistake, although unwilling that the builder should suffer, might be tempted to "make it up" to the builder in some other way during the progress of the works—although, of course, no honourable man in the architectural profession would seek to screen himself from a mistake in that way. That was one very great reason why the Quantities should

be made part of the contract. All the squabbling that now so frequently arose would be obviated if that course were adopted. All things considered, he thought the right thing was for the architect to be perfectly independent of the Quantities, which should be prepared by a Quantity-surveyor appointed by him and paid by the employer. The drawings sent to the Quantity-surveyor should be thoroughly well prepared, and accompanied by a good specification. He believed that it was often to the slovenly and insufficient drawings of the architect that much of the complaint heard against Quantity-surveyors was due. No wonder that it was charged against Quantity-surveyors that they did not know so much of a building as its architect. The incompleteness of the drawings from which they had to work prevented them from knowing all they should, in order to properly take out the Quantities of the building. It was sometimes the custom for the Quantities to be taken out by the architect in conjunction with a surveyor. That was a sort of go-between or compromise, and was, he thought, a mistake; for, in most instances, the two men would not be equal, the professed surveyor being a better man at Quantities than the architect. Then, when the work thus jointly done was completed, who was to be paid for it? He supposed the commission was to be shared between the two persons. If so, was one per cent. on the cost of an ordinary building a sufficient remuneration for each person's work? He supposed not. But was more to be charged? If so, would not the client suffer? He thought so. It was, he thought not at all an uncommon thing for the surveyor to prepare the specification after the Bill of Quantities. That was an objectionable course in itself, for the architect ought not to send out his work half done—drawings without specification—to the surveyor. But in cases where the specification was prepared by the surveyor, he ought to be paid for it, and if he did it without being paid for it by the architect, it was tantamount to sharing the commission for the Quantities.

CHARLES ALDRIDGE, President of the Liverpool Architectural Society, *Fellow*, said that he supposed that all present would be agreed that the taking-out of Quantities was a necessary adjunct and process in making a building contract. Great as were the advantages of the practice, there were some disadvantages. When he was in a provincial architect's office some fifteen or twenty years ago, the Quantities were not taken out at all; when estimates were invited, the builders came to the architect's office and took out their own Quantities. No doubt there were disadvantages under that system, but it nevertheless possessed advantages which were sometimes overlooked. One advantage of the old system was that under it the architect had to prepare most careful drawings and specifications before an estimate could be given; another advantage was that under it each builder had to make himself thoroughly well acquainted with the drawings and specification before he sent in his tender. The practice of tendering for works as conducted at the present day was generally a mere question of figures, and very often it happened that, in the case of important buildings, the persons tendering never troubled to look at the drawing or specification describing the work of the various trades required in the erection of the buildings. That was surely a very great disadvantage, and he could not help thinking that, in the wording of every tender submitted for a building, the contractor should say that he agreed to erect the building according to the plans, specification and Bills of Quantities, "having had the opportunity of studying the specification and drawings," or words to some such effect. With regard to the question of the advisability of the architect taking out his own Quantities, he, as a provincial architect, partly by force of circumstances and partly by inclination, had been compelled to take out his own Quantities, and he was very much in favour of the practice, for several reasons. In the first place, it was necessary for the architect to be thoroughly conversant with the practical details of his profession, and there could be no better test of that knowledge than his ability to take out the Quantities of his buildings. How cheaply might not a young architect, ignorant of practical details, get into practice on his own account with the help of a friendly Quantity-surveyor! He need only make very slight sketches of his proposed building: his friend the surveyor would put the building together for him. Neither need the young architect trouble himself to write a specification; the friendly Quantity-surveyor said—"Don't trouble yourself about the specification; I will write it for you." Well, the building went on; perhaps by good chance no difficulties arose for a time, but sooner or later they would arise, and then the young architect had to run to and fro to the Quantity-surveyor to know how things were to be done. All these difficulties arose through the architect not possessing that practical knowledge of his building which he would obtain in the process of taking out his Quantities, were he able to do so. If he continued in practice he sooner or later found it necessary to acquire that ability, at the loss of an amount of time which he could have better spared when a younger man. It was an absolutely essential condition of provincial architectural practice that the architect should take out his own Quantities. When he commenced practice in Liverpool ten years ago, in the first buildings he erected there, he employed a London Quantity-surveyor, but he found the arrangement unworkable, owing to the distance from London. In Liverpool there were very few Quantity-surveyors as they were known in London. There were some architects in Liverpool

who combined the taking-out of Quantities with general practice as architects, but for obvious reasons he did not think it desirable to let his drawings go into the offices of other architects in the same town. He was therefore compelled to adopt the practice of taking out his own Quantities, and he had never regretted it. Several advantages of that practice had been touched upon by the various speakers, but there was one great advantage which could not be too highly thought of, namely, that the architect who took out his own Quantities had to build his building, so to speak, stone by stone. Nothing could escape his eye in the process. He was compelled to consider and surmount difficulties in construction as they arose, and he was able to form an accurate idea in his own mind as to what the building would cost. The process also enabled him to save a great deal of his client's money, and, on the whole, the building came out with a much more favourable result than if it had been put into the hands of a Quantity-surveyor. Quantity-surveyors were but mortal, and they no doubt felt they were more or less responsible for the accuracy of their Quantities. They, therefore, took care to err rather on the right side, *i.e.*, that there should be a sufficiency of everything. As to the payment of architects for the Quantities of their own buildings, it had been urged that it was not desirable that there should be money payments from the builder to the architect; but it seemed to him to be a matter of very little moment whether the client paid the architect direct for the Quantities, or whether the builder paid the architect with the concurrence of the client. In his own practice he made the Quantities a part of the contract, in conjunction with the drawings and specification.

J. DOUGLASS MATHEWS, *Fellow*, said that they had been almost exclusively looking at the question from the point of view of what would be to the relative advantage of the architect and the builder. But, what of the client? As architects, they knew perfectly well that when a client came to them he gave them his confidence, expecting them to take every means to carry out the building to his satisfaction. There were, no doubt, some architects who were in a position to dictate to their clients as to the exact course to be pursued, and to refuse a commission unless their views were met. He, however, speaking as a general practitioner, could not help thinking that if he went to a client who had given him his confidence, and told him that he had prepared plans and specification, but that, when the work had reached that point, he had put it in the hands of another person, a stranger, for the purpose of taking out the Quantities, the client might very naturally not feel that confidence which he had felt in the architect alone; in short, the confidence between client and architect would be in a great measure lost. He was most decidedly of opinion that the client did look to the architect to carry the whole of the matter through for him, and to protect his interests. He, therefore, quite agreed with the remarks, which had been made by almost all the gentlemen who had preceded him, as to the desirability of the architect taking out his own Quantities. Mr. Tavenor Perry had said very much what he (the speaker) had intended to say. Never had he regretted taking out his own Quantities; it had been of considerable advantage to him in carrying out works, and it had been advantageous also to his clients. He thought that one thing for the Conference to consider was, should it be part of the architect's education to understand the taking-out of Quantities? He thought they would agree that it ought to be. The architect clearly ought to understand how work should be measured, for he would need such knowledge not simply in the taking-out of Quantities in the first instance, but in the settlement of accounts at the end of the contract. If the Quantities were taken out by the surveyor, it was perfectly certain that the surveyor must be called in at the end of the job to adjust the accounts. As many gentlemen present would know, when the surveyor was called in at the last moment, he took his instructions to a great extent from the builder's foreman (he was speaking of cases where a clerk-of-the-works was not employed), and consequently from the *ex parte* statement he could not help leaning rather to the side of the builder. There seemed to be a general feeling that all architects made mistakes in taking-out Quantities; he did not know why an architect should make mistakes in Quantities any more than in drawings or specifications. The architect who acted as his own Quantity-surveyor was able to perform his duties as arbitrator between client and builder with a facility that he would not otherwise enjoy, and would be able to hold the balance evenly between the two parties. A great deal had been said about architects being easily swayed to one side or the other, but such men were not entitled to the name of architect. An architect ought to have the full confidence of both client and builder, and should be above suspicion. In the absence of the architect supplying his own Quantities, a course was sometimes adopted (and he thought with very good results in works of ordinary magnitude) of calling in the surveyor to sit down to the Quantities with the architect. He thought that course was calculated to have a very beneficial effect upon both parties. By adopting it the architect could tell the surveyor exactly what he intended by his drawings, and the builder would doubtless feel more confidence in tendering. He thought that the practice was growing up of doing without Quantities altogether, going to two or three builders, and asking them to tender from drawings and specification, each taking out his own Quantities—in many cases with satisfactory results to all concerned.

J. MACVICAR ANDERSON, *Hon. Secretary*, said that it seemed to be the practice in the provinces for architects to take out their own Quantities, and from what had been said, he did not think it would be desirable for the Institute to attempt to legislate on the subject just now. If the question were asked of him individually, he should say that it was most undesirable for architects to take out their own Quantities. No doubt an architect was a man of business, but he should not be solely a man of business—he was also a professor of a Fine art, and, in his (the speaker's) opinion, the more he strove to excel as a professor of that art the more highly would he be esteemed. The argument used : that it was in some instances necessary for young men entering the profession to combine the practice of Quantity-surveying with that of architecture, in order to eke out a living, was no doubt one of some force, but in his judgment the question was not so much one of expediency as of principle. He thought that the Conference in discussing the matter should take higher ground than that. Mr. Medland Taylor objected to call in a Quantity-surveyor because he thought such a course would be to commit his client's interest to another person not contemplated by the client, but he (the speaker) denied that that was the case. When the drawings went to the surveyor there was constant intercommunication between him and the architect. On the question of payment he (the speaker) would strongly urge that, where architects did take out Quantities for their works, it was essential that they should not make their charge for them through the medium of any tradesman, for he thought that no professional man should make a charge in respect for any services, or receive payment for such services, except from his employer direct. Even where a surveyor took out the Quantities, he thought that the charge for them should be made direct to the employer, and not to the builder. With regard to Mr. Douglass Mathews's remarks about the client objecting to the work going into the hands of a stranger, in the person of a Quantity-surveyor, he thought there was no force in them ; the same argument might just as well be applied thus :—The client might say to the architect, "I employ you to design my house for me, but I object to you employing a builder to carry it out." There would be just as much force in the one objection as in the other. As to the question of the Quantities forming part of the contract, he would venture to ask why should they not? The question had never arisen in his own practice, but practically, as everybody knew, the Quantities always were the basis of the contract, for when there was a dispute, the first question that was put was, "What do the Quantities say? How is it taken?" The question of sharing commissions for Quantities, he thought was a desirable point to be referred to. For his own part, he was quite unaware that such a practice existed until a recent case brought it to his knowledge. The practice had been sought to be justified by urging that the architect had to check all the measurements, &c. He, however, maintained that the practice was a highly improper one, and although he had been informed that it was not an unusual one, he trusted that that was not the case. He thought it extremely desirable to let it go forth from the Conference that such a practice was repudiated by all the honourable members of the profession, as one which was altogether improper, and greatly to be deprecated. Mr. Rickman, in some remarks made on Saturday, seemed rather to object to any legislation on the subject, owing to the constant changes which were occurring; but that would be an argument against all legislation. Would it not be possible to lay down some general rules for the guidance of the profession in these matters as the result of the Conference discussions?

Mr. F. J. DOVE, of the firm of Messrs. Dove, Bros., said that he wished to be allowed to state, most distinctly, that no builder of any repute in London or elsewhere desired to be paid for anything more than he undertook to do; and whether the work which he undertook to do was set out in Bills of Quantities prepared by qualified surveyors or by qualified architects, it mattered little to the builder, so long as the Quantities were made part of the contract. Without such a condition builders were not likely to tender on the Quantities prepared by architects, for such Quantities were too often prepared in such a way as to utterly mislead the builder, and against Quantities prepared by inexperienced hands the builders had no protection unless they were made the basis of the contract. It seemed to him that there really was a great deal more mystery made of the subject of Quantities than there was the slightest occasion for. One commendable practice, pursued by some country architects who were their own Quantity-surveyors, was that of giving very copious sketches of detail on the margins of the Bill of Quantities. That course was not adopted to any general extent, although so valuable and useful to the builder, in assisting him to put a just price upon the work. Why the practice was not more extensively adopted he did not know; the only reason he had ever heard assigned for not carrying it out in London was that some architects were so proud of their position as architects, and of the details of their art-work, that they objected to their details being "hawked about" in surveyors' offices. He thought that it would be far more satisfactory to the building owner or client if the Bills of Quantities formed part of the contract; he would then see exactly what he was getting, and would know what he was paying for. He trusted that an opportunity would occur for some further discussion, between architects, surveyors and builders, of the questions involved.

The CHAIRMAN said that the following suggestions had been submitted to him, and that he should like to have Mr. Dove's opinion as to the possibility of their acceptance by the builders. The suggestions were—

"That the surveyor should invariably be employed by the proprietor directly, or in the usual way through the agency of his architect.

"That he should be the servant of the proprietor (building owner) *quoad* the quantities, and should be responsible to him.

"That he should be under the control of the architect, and his work and accounts subject to his supervision, exactly in the same way, and to the same extent, as anyone else employed.

"That he should be invariably paid for all his services by the building owner.

"That the Bills of Quantities should always form the basis of the contract, and that the contractor should be required to furnish the architect with a complete schedule of his prices."

Mr. F. J. DOVE thought that, speaking as an individual builder, there would be little or no objection to the majority of these proposals. He thought that the third suggestion would be likely to lead to litigation. He did object, however, to the requirement that the builder should furnish the architect with "a complete schedule of his prices," which was a manifestly unfair requirement.

Mr. ROBERT SCOTT observed that some of the speakers had expressed an opinion that architects ought to take out the Quantities for their buildings because, when they were articled pupils, it was the custom to take out the Quantities of works, the drawings of which were prepared in the offices in which they were articled. That argument, he thought to be untenable, for in the same way it might be urged that builders should also be architects in the present day, because of the undoubted fact that, a century or more ago, the eminent architects in Glasgow were also builders, and carried out their own works. Mr. Medland Taylor, he thought, had stated that the builder's estimate, based on the Bill of Quantities prepared by a surveyor, often exceeded the estimate of the architect; but it might happen that the Quantity-surveyor might have insufficient material in the shape of drawings to work from. He begged to differ from the gentlemen from Edinburgh in their statement that the Edinburgh system was the best. He stood up for the Glasgow system. He was glad to have heard the remarks of Mr. Picton and Mr. Francis Turner in favour of the Glasgow method, and he would only say that if in England the architects committed themselves to the principle of making the Bill of Quantities part of the contract, they would be practically adopting the Glasgow system.

LAWRENCE BOOTH, *Fellow*, said that he agreed entirely with Mr. Medland Taylor's Paper. He did not think by any means that it ought to go forth, as the recommendation of the Conference, that it was an undesirable thing for the architect to take out his own Quantities. He had been in practice in Manchester now for something like five and twenty years, and in the earlier part of his experience he had been in offices where it had been the invariable rule for the architect to take out his own Quantities. His own practice had been to take out his Quantities, and to make them the basis of the contract—the Quantities as explained by the contract drawings and specification. He had never had a lawsuit in a very considerable experience. He thought that the element of danger was introduced when it was endeavoured to fix a financial responsibility for the accuracy or inaccuracy of the Quantities upon the architect or surveyor who might have taken them out. No such infallibility was assumed by architects in good planning and designing—duties quite as obligatory on them as absolute accuracy in the computation of measurements. If the client paid more than he expected he would have to pay, he got his money's worth, and the architect's desire to preserve a reputation for accuracy was a sufficient guarantee that he would not wilfully or carelessly mislead him in such an important matter. When a client came to him, he spoke plainly and frankly to him, and told him that it would be necessary that he should supply the builder with a copy of the Quantities, and that, therefore, the Quantities would have to be taken out and charged for. He seldom had any trouble in getting the client's promise to pay for them, and he frequently found the client preferred that the architect should take out the Quantities. As an instance, some time ago, a public body in the neighbourhood of Manchester promoted a scheme for a building to cost about £60,000. The committee who had the matter in hand was presided over by a civil engineer of some eminence, and included several gentlemen of practical knowledge, and he felt greatly honoured when the committee waited upon him, without instituting a competition, and invited him to undertake the commission, but they made it a *stipulation* that he should take out his own Quantities, and that the Quantities should be made the basis of the contract. In the matter of payment for the Quantities, some of his clients paid him directly themselves, but when they did not do so, he frankly told them that the builder would pay him. Under such circumstances there was no room for any doubt or suspicion as to the *bonâ fide* character of the architect's decision when adjusting the account between the client and the builder.

ALFRED WATERHOUSE, A.R.A., *Member of Council*, said that there was an enormous advantage in

making the Bills of Quantities form a part of the contract, and he was disposed to advocate the making of the Bills of Quantities alone, without including the specification, form the basis of the contract. That system carried with it the advantage that the Quantities would, in many instances, be more likely to be taken out with absolute correctness. A very small margin in excess in each item might easily amount in the aggregate to a sum equal to the architect's commission.

Mr. WILLIAM WATKINS thought that the payment for Quantities should invariably be made direct by the building owner. It had been his practice to have the Quantities of his buildings taken off in his own office, at Lincoln, under his own superintendence, and to make them form part of the contract. Like Mr. Tavenor Perry, he had adopted the practice of writing his specification after the Bill of Quantities had been prepared. His experience was precisely that of other speakers who had referred to the necessity that existed for provincial architects taking out their own Quantities. He was compelled to do so himself, for there was no Quantity-surveyor in Lincoln, and the members of the local builders' association had refused to tender for any building the cost of which would exceed £300, except on guaranteed Quantities.

Mr. SIDNEY YOUNG said that Mr. Macvicar Anderson had so fully expressed his (the speaker's) views in the matter, that he had very little to say in addition to what he had already said in his Paper. There was one point, however, which had been somewhat overlooked, or, at least, only slightly touched upon, and that was the question of the special education of architects for the taking-out of Quantities. He thought everybody in that room was aware that, as a rule, an architectural pupil had very little time indeed, during the term of his pupilage, to study the method of taking out Quantities; he was generally too fully employed with the T-square and the set-square during the five years of his pupilage. It was well known to be the fact that a young man who served a pupilage of five years to a Quantity-surveyor, dealing with Quantities alone during that period, was very seldom a thoroughly qualified surveyor when out of his time. How, then, could it be expected that an architectural pupil, who had to devote a great portion of his time to other things, could properly learn to take out Quantities, even supposing he were articled in an office where the Quantities were taken out by the architect or under his superintendence? If a Quantity-surveyor attempted architecture, he was laughed at, although, from his having to deal with architects' work, he might fairly be presumed to know something about it, but it seemed to be, in the opinion of some gentlemen, an easy thing for an architect to be also a Quantity-surveyor. He most fully agreed with what had been said, that when an architect took out his own Quantities it was desirable that they should form part of the contract; but he also thought that if Quantities prepared by anyone who called himself a surveyor were made part of the contract, it would lead to the springing up of a class of surveyors, specimens of whose work had been furnished in the extracts which had been read from Mr. Hughes's Paper. He thought the Glasgow system was a very good one, but he preferred the London one. He thought that the laugh, caused by Mr. Pratt's observations, to the effect that builders preferred to tender upon the Quantities provided by the Quantity-surveyor rather than on the Quantities furnished by the architect, arose from the misapprehension of his meaning. He thought that what Mr. Pratt meant to say was that the builders preferred to tender upon the surveyor's Quantities, not because they were in excess, but because they were more clearly drawn up. In his limited experience he had found that more litigation arose out of the Quantities taken off by the architect than out of those taken off by a surveyor.

Mr. MEDLAND TAYLOR, President of the Manchester Society of Architects, confessed to a feeling of agreeable surprize that the arguments contained in his Paper had met with so little real antagonism. He thought that most of the arguments which had been adduced in the course of the discussion were on the side of his Paper. Mr. Young had said that pupils of Quantity-surveyors, after serving articles for five years, did not know very much about the taking-out of Quantities. In reply to that he (the speaker) would be inclined to ask, "How should they?" If they had been in architects' offices where the Quantities were taken out, they would probably have known much more about the work. Mr. Dove had said that builders only desired to be paid for what work they actually did. His (the speaker's) Paper had shown how that end might be attained. Mr. Fowler's arguments were, he thought, very strongly on his side. He admitted that nothing was so calculated to teach the young architect a knowledge of the details of construction as the practice of taking out Quantities, but somewhat curiously went on to argue that it would be better that the Quantities should be taken out by the Quantity-surveyor, because the tendency of the day was towards "specialism." Well, that was certainly something like "special pleading." With regard to the examples of deficient Quantities quoted by Mr. Hughes, of course builders in the position of Mr. Hughes and Mr. Dove would not tender upon such Quantities, and would decline to carry out works under architects from whose offices such Quantities had emanated. The views which had been expressed by Mr. Randal, of Shrewsbury; Mr. Hine, of Nottingham; and Mr. Tavenor Perry, were very

important. He agreed with Mr. Perry's conclusion (though he did not give expression to it in his Paper) that the architect who took out his own Quantities could save his client 10 per cent. on the cost of a building.

JOSEPH GODDARD, President of the Leicestershire Society of Architects, *Fellow*, agreed very much with what Mr. Tavenor Perry had said. The custom in Leicester had been for the architects to take out their Quantities and make them part of the contract, and at the conclusion of the contract to supply the builder with a copy of the deductions and extras. He should be inclined to deprecate exceedingly any recommendation going forth from the Council of the Institute, or from the Conference, to the effect that it was unadvisable for architects in the country to take out their own Quantities, if they chose to do so. The result of the abandonment of the present method of procedure would be to send out into the world a very much larger number of incompetent young men as practising architects than was the case now. There would be no one more pleased to avoid the responsibility of taking out Quantities than himself, but he did not see his way to do it. His practice, and the practices of most provincial architects, consisted almost exclusively of small works. He might add that he was considered in the town in which he practised as a "most expensive" architect, because his charge was 7 per cent., including payment for the Quantities. It was sometimes objected to his charge, that they could get a London architect to come down and take the commission for 5 per cent. on the outlay, but the client forgot that the other 2 per cent. came out of his pocket indirectly in the shape of the payment made by the builder for the Quantities, which he, of course, took to recoup himself in the amount of the contract.

EDWARD BOARDMAN, *Fellow*, said that he should not be able to carry out his designs, in Norwich, if he did not take out his Quantities, for respectable builders would otherwise refuse to tender. He always consulted his clients as to whether he should take out the Quantities, and he generally succeeded in getting their consent to do so.

THE CHAIRMAN in closing the Discussion observed that, even if the Conference could not arrive at any very definite result, much satisfactory progress had certainly been made in the formation of opinion on the subject; and the publication of the free expressions of opinion during the discussion would be an advantage to architects as well as Quantity-surveyors. Without attempting to review the whole of the Discussion, which would occupy too much time, he would refer to the old system now occasionally adopted for large works: that when the working drawings and specifications were completed, they were placed in the hands of two surveyors, the one representing the employer and the other the builder, who respectively and conjointly applied their skill to the preparation of the Bills of Quantities. Probably no system could be more perfect, because the architect had applied his knowledge and ability to the preparation of these documents, and had made them, so far as he could, complete, while in the subsequent operation of taking out the Quantities the surveyors exercised their ingenuity and skill to discover any defects that might exist, the result being most satisfactory to all parties; but it was a long process which, in this age of haste and hurry, would hardly meet with commendation from clients anxious and desirous to get on with the work, and who, hardly giving time for the preparation of sufficient working drawings, urged on the commencement of the work as soon as the design was settled. Hence another and perhaps less desirable system had grown up. The architect employed a surveyor in whom he had implicit confidence, and who was fully acquainted with the style and character of the details of his designs and the systems of construction he adopted. Thus, before the working drawings were completed or the specification written, the surveyor was able to make great progress with his work; the production of the Bills of Quantities was expedited in a remarkable degree, there being a very great saving of time; and the drawings and specification being subsequently completed to accord with the Quantities. But in such a system the builder was not represented, and might fairly object to accept, as correct, Quantities furnished by the surveyor so employed; under such circumstances it was but reasonable that the Quantities should be made part of the contract and that the surveyor should be considered as the representative of the client—it would be better in fact that in such case he should be paid

direct by the client, and his position would then be accurately defined—though the surveyor might appreciate some disadvantage in this case, for being thereby relieved from his responsibility to the builder, of guarantee of accuracy, the scale of his remuneration would necessarily be less. Objections were often raised to the high scale of surveyors' charges, but they certainly were not too high, when the surveyor guaranteed the Quantities and held himself responsible to the builder to make good deficiencies. It was sometimes alleged that surveyors took out their Quantities "full" in order to secure themselves from being called upon to make good mistakes in the way of omissions. Any such course was absolutely dishonest and anyone so acting would not be worthy of the name of Quantity-surveyor; if the drawings and specification supplied by the architect were sufficient and complete, the Quantities might be arrived at with at the least as much accuracy as could be attained by a subsequent measurement of the building, and there could not be any justification for so improper a course. If the Quantities were made part of the contract, and the surveyor was relieved of the responsibility of guarantee, he must accept remuneration on a lower scale. It had also been urged that such a change might lead to carelessness and negligence in the preparation of Quantities, and render a re-measurement afterwards necessary, but there would not be much difficulty in protecting the client against such a contingency, and a surveyor who allowed himself to be so influenced would speedily sacrifice that confidence in him on which his employment rested. The Glasgow system—excellent as it might be—would hardly commend itself to London practitioners. It had been exhaustively discussed when brought before the Institute by Mr. Honeyman some little time back, but he did not make many converts. The English system of obtaining a lump-sum tender of a definite amount, for which the building could be carried out, provided the architect did not change his fancies nor the client himself make alterations, had more to commend it; and happy was the architect whose client going abroad as soon as the contract was signed did not return till the work was complete. Allusion had been very aptly made to the modern practice of sub-division of labour, an excellent thing in so far as it enabled a man to devote himself thoroughly to specialities in which he might acquire extreme proficiency. Nothing could be more conducive to the interests of the two professions, and to the advancement of architecture, than that the work of the architect and of the measuring-surveyor should as far as possible be kept distinct. A young architect might with very great advantage to himself spend a few months in the office of a Quantity-surveyor, and by close application acquire such a knowledge of the details of the work as would in his subsequent practice stand him in good stead; but in this interval he should on no account suspend his architectural studies, nor allow the knowledge thus gained to be used for the purpose of adding to his income, to the detriment of his proper profession. It would be a grave misfortune for him if, lured by the desire of gain and immediate emolument, he allowed the golden hours available for the study of architecture to flee away, while he wasted the time he could never recall, in the drudgery of mere money-making. For, however valuable acquaintance with the surveyor's art might be to an architect, it was given but to few to attain even moderate success in both branches, and the continuous practice of Quantity-surveying could not but exercise a most detrimental influence upon the art studies of a young architect. Mr. Fowler Jones spoke of the difficulties that arose from having to deal with different trades when distinct contracts were made with different tradesmen, and this no doubt threw a considerable amount of labour on the architect, but it was matter of grave consideration whether the

artizans of this country had benefited in technical skill, or architects and clients derived equivalent advantage, from the fact that most builders were now only capitalists who frequently farmed out the work to others, in the several branches of trade, who thus did not come directly into contact with the architect, but were mere agents for the creation of additional gain to the great capitalists for whom they worked. It would be a very great advantage to the working men and artizans, not less than to the client, if the architect could be brought more directly into communication with the actual handicraftsman than seemed to be possible under the system of lump-sum contracts. As to the practice of architects taking out the Quantities for their own works, forcible as appeared the arguments which had been urged in favour of such a practice, and admitting the peculiar position in which some provincial architects were placed, as also the advantage which an architect derived from the knowledge of his building, which he acquired by taking out its Quantities, he (the Chairman) decidedly thought it undesirable for architects to pursue the practice, unless compelled by circumstances to do so, in which case the Quantities should be made part of the contract; and the Conference had been successful in bringing together an aggregation of virtuous architects who adopted that course. But there was another class of architects who, with a mere desire for gain, and without being qualified to do so, took out their own Quantities, and as a consequence landed their clients, or the builders, in difficulties of all kinds. The practice of such architect-surveyors, often extremely incompetent, seeking to escape responsibility and to indemnify themselves against risk by adopting headings such as those commented on in his opening observations, merited severe reprobation; such men, while frequently charging the highest possible rate for their imperfect work, sought by such measures to escape responsibility, and to throw it on the builder, who of course after a little experience took care to protect himself, to the serious detriment of the client. It was the men who had the effrontery to put such conditions as he had read, as headings to their Quantities, who brought discredit on the profession, and if this Conference elicited an expression of opinion to that effect it would be satisfactory. Reference had been made to the Institute Schedule of Professional Charges, and there appeared to be an impression that the rate of remuneration was fixed thereby. There was no authority for such an idea. The Institute Schedule simply laid down, as an established principle, that, in the absence of an agreement to the contrary, the ordinary rate of remuneration for an architect was 5 per cent. on the outlay. When a gentleman learned in the law advanced in his profession and "took silk," he increased the scale of his fees. Why should it not be a recognized principle in the architectural profession that, when a man arrived at a position in which his services were in great demand, he should value those services higher, and stipulate for payment at the rate of 7 or 10 per cent. on the outlay? And why should young men just entered in the profession be expected to charge as much as 5 per cent. if it suited them to agree to accept less? These observations must not be understood as in any way implying or throwing doubt on the accuracy or authority of the Institute Schedule, which he entirely endorsed; they were directed to the erroneous idea that such Schedule was a sort of trades-union document binding Members to one uniform scale in all circumstances.

*** The Chairman concluded by putting to the meeting a series of three resolutions, which were carried *nem. con.* These, which, in accordance with the request of the meeting, were submitted to the Council of the Institute on the 23rd of May, 1881, will be found at page 259 of the Journal of PROCEEDINGS, 1880-81.

Conference Fourth Meeting.

DISCUSSION ON ARCHITECTURAL COMPETITIONS.

[Tuesday afternoon, 10th May, 1881, Professor Kerr, *Fellow*, in the Chair.]

The CHAIRMAN introduced the subject by recalling attention to the memorial circulated by Mr. Cole A. Adams, and presented to the Institute a year ago by Mr. Street, praying that body to take steps to insure united action on the part of the profession in order to prevent the abuses of the Competition system. That memorial was signed by more than 1,300 architects, who expressed themselves willing to bind themselves not to take part in any Competition unless "a professional adjudicator of established reputation" were appointed. The signatories included men of all degrees of standing in the profession, including a large number of the Fellows and Associates of the Institute, and of the members of provincial, Scotch and Irish professional societies, as well as a large number who were not members of any such society. The memorial was duly brought before the Council, and the Institute still had the subject under consideration. The Institute had, eight years previously, in connexion with the Architectural Conference of 1872, directed attention to the subject in its "General Conditions for Architectural Competitions," which, although, so far as they went, good and to the point, were certainly capable of great improvement in many respects. The result of the presentation of the memorial by Mr. Street last year was the initiation, at the instance of Mr. Thomas Porter (who read a Paper before the Institute on the subject shortly after the memorial was presented), of a new movement to improve the conditions of Architectural Competitions. A special committee to consider the whole subject was appointed by the Institute. Of that committee Mr. Charles Barry was appointed chairman, himself (the speaker) vice-chairman, and Mr. Porter honorary secretary. That committee had held a great many meetings, and, without undue delay, presented a report to the Council containing certain recommendations. That report, if it had a fault, was rather too elaborate. There was a well-known maxim in literature, that the writer who exhausted his subject exhausted his reader, and that maxim had not, perhaps, been sufficiently borne in mind by the committee. But the Council of the Institute passed a resolution on the subject to the following effect: That, inasmuch as the report appeared to deal only with a part of the subject contained in the resolution by which the committee was appointed, it be referred back to the committee, with the request that they should consider as to the appointment of professional assessors or judges of designs sent in in competition. The committee had again reported to the Council, but unfortunately their report could not be brought before the Conference, as it was awaiting consideration by the Council. The matter, therefore, came before the present meeting in a somewhat informal manner. Mr. Porter, in his Paper before referred to, had prepared some very elaborate tables as to the pecuniary results to the profession of a number of Competitions extending over a number of years. Those tables went to show that a very large sum of money indeed—taking Competitions in groups, and not in individual cases—was invariably actually disbursed by the competitors, as against a very much smaller sum accruing to them in the shape of premiums and commission on the works when they were allowed to carry them out. The result, in other words, of Mr. Porter's calculations was that the whole of the profit accruing to the successful competitors was often far more than exceeded by the expenses of the unsuccessful competitors. That was a state of things which architects, as commercial and business men, could not be expected to tolerate longer than they could help. It was a great grievance, and insult was added to injury when the members of the profession were not only mulct in the expense of competing, but were treated with unfairness, and often with offensiveness, when they did compete. As the report of the committee could not, for the reason given, be placed before the Conference, he might briefly state the result of the deliberations. Two leading principles had been brought into view. One was the desire to secure fair play, and the other was the desire to secure something like, not profit, but payment for services rendered to the promoters of Competitions in competing. Looking at the matter in a commercial aspect, both of those principles were undoubtedly sound ones. Probably some of those who had taken part in Competitions might be inclined to despair of getting fair play in regard to the selection of designs—at any rate, under generally existing conditions; and with regard to the other point, unless the public recognized that an Architectural Competition was something worth paying for, architects practising in a commercial country might very fairly hesitate to continue to compete. He would like to mention also that one of the members of the committee had written a few lines expressing his own opinion to be, that the system of Architectural Competition without direct and adequate remuneration to the competitors at large was extremely objectionable, and could only tend to the aggrandizement of some of the competitors at the expense of the others. If, however, Competitions could be

conducted on the principle of adequate payment to competitors for their services and expenses in competing, then, the writer thought, Competitions might be encouraged, it being, however, a necessary condition that a professional adjudicator should be appointed. Such, then, was the present condition of the question. Architects wanted to know whether they could get fair play in the adjudications upon Competitions, and whether they could not, as a condition precedent to competing, secure promise of reasonable payment for competing, whatever might be the result of the Competition as to the selection of their designs. If these two points could be conceded, then, he thought, Competitions might be made of great service to the profession, and might be encouraged rather than discouraged. There were various matters of detail involved in the consideration of these points, but, broadly stated, the questions that had to be discussed might be put thus : Firstly, whether the appointment of a paid professional assessor in Competitions would not practically secure fair play in adjudication ? secondly, whether, in addition to fair play in the matter of the awards, architects ought not to be remunerated to some reasonable extent for their services in competing ? and, thirdly, whether, if those two points could be secured, the Conference would be prepared to say that Architectural Competitions under those conditions should be encouraged rather than discouraged ?

JAMES BROOKS, *Member of Council*, said that, as regarded the appointment of an assessor to judge of the merits of the designs submitted in competition, the proposal was a good one enough in itself, so far as it went, but something more should be done than that. The professional assessor should be appointed from the first, and should draw up the instructions to competitors. The latter requirement was quite as essential to justice being done as the appointment of a referee to report on the merits of the designs submitted. He had seen a large number of conditions of Architectural Competitions, which were drawn up by people who were wholly incompetent for the task, and he could only say that such conditions were often of such a character that a competing architect, instead of complying with them, had to consider what was meant by them as a whole, and to exercise his discretion in departing from them. Tested by such impossible conditions, very often the best designs would be rejected. He would like to add that some good had been done by the Institute Paper of General Regulations as to Architectural Competitions. In his younger days he had never heard of such a person, in connection with Competitions, as a professional assessor, but such appointments were frequent now, and that was largely due to the action of the Institute.

HENRY DAWSON, *Fellow*, expressed regret that the report of the committee, which had been before the Council, could not come before the Conference, for without it, it seemed to him, they had no definite proposals to discuss, and the discussion must tend to be of a desultory character. As to the points which the Chairman had tersely but tentatively put forth for discussion, he (the speaker) did not think that there could be much doubt that the appointment of professional assessors, to adjudicate upon designs sent in, would go a very long way towards securing fair play in the awards, and more especially so if the assessor's duties were to consist, as suggested by Mr. Brooks, of something more than the mere reporting upon the designs after they had been sent in. It was, he thought, a defect and shortcoming, in what was asked for by the memorial on the subject presented to the Institute last year, that the professional assessor's duty was proposed to be limited to adjudication after designs were sent in. Mr. Brooks's suggestion, he might state, was anticipated by the report of the committee, who thought that the assessor should not merely be called in at the end of a competition, but that his duties should begin with the initiation of a competition, so that he should assist in framing the instructions to competing architects. It was greatly to be regretted that the report of the committee could not be brought before the Conference, because as the subject had been thoroughly thrashed out by them, it would have been very desirable that their conclusions should have been laid before the Conference by the Council. The appointment of a professional assessor should most decidedly be made from the first, and he should be at the service of the promoters and of the competitors to answer all reasonable questions. When he came to examine the designs submitted, it should be his duty to rigidly exclude all that did not strictly conform to the conditions laid down ; and after carefully examining and comparing the remainder, he should give his decision as to which was the best design, the author of which should be intrusted with the carrying out of the work. As he (the speaker) was precluded from reading the recommendations of the committee's report, he might, he thought, very fairly say that the recommendations quoted in the annual report* of the Institute, as having been made by the Council of that body to the Glasgow Town Council (in response to the invitation of the Lord Provost), embodied all the principal points insisted upon by the committee in their report; indeed, the conclusions of the committee and the recommendations of the Council, with reference to the Glasgow Municipal Buildings, were practically identical.

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* These ten recommendations are printed at page 225 of the Journal of PROCEEDINGS, 1880-81.

THOMAS PORTER, *Fellow*, said that it was due to the committee, and to the Council of the Institute, that he should explain that the committee's report had been sent back by the Council for reconsideration owing to the non-observance by the committee of a peculiar technicality in the wording of the reference, which was that the committee was to "take into consideration the subject of Architectural Competitions . . . . . in concert with other London and provincial societies." The committee had, however, thought it desirable not to communicate with other societies until the Council had expressed an opinion on their suggestions. He might add that the first recommendation of the committee was that a professional assessor should be appointed from the first to draw up the conditions of Competitions, and to adjudicate upon the designs submitted. Another important recommendation of the committee was that premiums, as such, should be abolished altogether. In some Competitions it would be desirable that, in the first instance, architects willing to compete should be invited to send in their names. From the names sent in a selection should be made, and those selected should be invited to join in a preliminary sketch-competition. From that preliminary sketch-competition should be selected the architects to compete in the final competition, all who were selected to compete in the final competition being paid for their trouble. Another recommendation of the committee was that the motto system should be abolished, except in the case of the sketch-competitions. Probably the Conference and the profession at large were not aware of the insignificant works put up to competition. More than half the Competitions advertized were for works under £2,000 apiece, and yet, he was sorry to say, for such works as many as twenty-seven designs were sometimes sent in. Such Competitions cost the profession a very great deal more than it got out of them. In three years he had made note of thirty-four Competitions for works costing £2,050 on an average. He had found that, in Competitions for small public buildings, one set of designs was prepared for every £76 proposed to be laid out. He thought it would be a very desirable thing to get all the Members of the Institute to abstain from competing for all works that would cost under £3,000. That was not a very great thing to ask, but it would effectually strike at one of the most serious evils in connexion with Competitions.

R. C. PAGE, *Associate*, said that the chief ground of complaint which the younger members of the profession had against the system of Architectural Competitions was unfairness in the adjudication. He thought it would be, if practicable, a very good plan to appoint a professional assessor from the very commencement of the Competition, but the difficulty would be to get that done, because, in many Competitions, the first that the profession knew of them was by the advertizements in the professional journals, after the conditions had been drawn up. He, therefore, did not see how the profession was to insist upon the appointment of an assessor from the beginning. He thought, however, that if the profession would combine (even though such combination might savour somewhat of trade-unionism), they would be able to secure some measure of justice and fair play by the appointment of an assessor to adjudicate upon the designs sent in upon the conditions framed by the promoters. If they were to ask for the appointment of an assessor from the commencement, they would probably get nothing. On the principle, therefore, that half a loaf was better than no bread, they must press for, and be content if they obtained, a professional assessor to adjudicate upon the designs. A great point would be gained if it were generally recognized by promoters that, in all Competitions, a professional assessor should be appointed to adjudicate upon the designs sent in. He did not feel so strongly on the commercial aspect of the losses by Competitions as Mr. Porter and the Chairman felt. Young men who entered upon Competitions for the most part did their own drawings. Such work involved, it was true, a great deal of labour, but unfortunately most young men who went in for Competitions had plenty of spare time, and the exercise which Competitions afforded them was a good one. He was inclined to think that Mr. Porter's estimate of the loss entailed by Competitions on the profession was in excess of the real facts of the case. He thought it would be desirable to restrict the number of drawings required, and to prohibit perspectives. On the whole, he thought that Competitions, properly conducted, might be made very beneficial to the younger men in the profession, but when Competitions took place they should be for an architect and not for a design.

THE CHAIRMAN asked whether it would not be possible, in cases where a professional assessor could not be appointed until after the instructions to competitors had been issued, to give the assessor, if called in in time, permission to issue supplementary Instructions to competitors? It certainly appeared to him that it would be futile for the Conference or the Institute to lay down a set of recommendations saying what things were desirable for promoters of Competitions to do. What was wanted was that architects should combine in the interests of justice.

COLE A. ADAMS, *Fellow*, said that, although the memorial presented to the Institute had been found fault with for not asking enough, it should be remembered that it would have been very difficult, if not impossible, to get 1,300 signatures to it if it had been more comprehensive, for on many of the recommendations

made by the committee in the report there was room for difference of opinion. The memorial was drawn up with the view of securing the adhesion of the profession to the broad general principle that a professional assessor should be appointed in all public Competitions, and he had no doubt that if the Conference approved of that principle (as he hoped it would), and if the Institute duly formulated it, all who signed the memorial would faithfully abide by it. If that one point were gained, a great deal more would go with it, and, gradually, some, if not all, of the conditions desiderated by the committee would become acknowledged both by competitors and promoters. Personally he agreed with the recommendations of the committee, but there was, it could not be denied, room for considerable difference of opinion upon them, and therefore it would not do to attempt to generally enforce them.

HAMPDEN W. PRATT, *Associate*, said that the question of the desirability of having an assessor was generally conceded; and that being so, architects had only to act upon that principle to secure a very appreciable diminution of the evils of the Competition system, for it was quite certain that the question of a fee to the assessor would stick in the throats of many promoters, and they would refuse to appoint an assessor on that account. The result would be that no architects worthy of the name would compete, and consequently Competitions would be abandoned, or would become a dead letter, and all small works would, very properly, be intrusted to some local practitioner without competition, except, perhaps, a competition limited to two or three of the local men. At present the only hope of the profession in the matter of Competitions was in getting architects to rigidly abstain from competing when a professional assessor was not appointed.

HENRY DAWSON, *Fellow*, suggested that when architects were invited, by advertizement or otherwise, to compete in furnishing designs for a building, they should, before doing anything in the matter, write to the promoters, saying that they would be willing to compete if a professional assessor were appointed not merely to adjudicate upon the designs sent in, but to approve and if necessary to revize the conditions of the Competition. A great deal could be done in the way of making known to the public the essential conditions for a successful Competition by means of the provincial societies. The public, or, in other words, the promoters of Competitions, should be fully given to understand that unless the conditions of proposed Competitions were framed within certain lines, architects of repute and respectability would not compete. One of the duties of the assessor should be to say whether the amount put forth in the conditions issued by the promoters as the cost of a proposed building was adequate and reasonable (in order that younger members of the profession, not experienced in questions of cost, might have something definite to go upon), as well as ultimately to say whether the designs submitted could be erected for the sums stated by the competitors. He could not too strongly condemn the practice, sometimes resorted to by persons who took part in Competitions, of stating that their buildings would cost a given sum, when they could only be erected for that sum by scamping. Such conduct as that caused the public to hurl accusations broadcast at the profession.

CHARLES ALDRIDGE, President of the Liverpool Architectural Society, *Fellow*, thought that the assessor should draw up the conditions of Competition. He had engaged in a great many Competitions, but had never seen any the conditions of which were entirely satisfactory. As to the alleged difficulties in the way of getting the conditions drawn up by the professional assessor at the commencement, he could not understand why, when a committee or a public body decided to initiate a Competition for a building, they did not do as they would do in any other matter of equal importance, viz.,—take professional advice on the subject. They should first of all settle what amount of money they would spend, and then they should consult their professional adviser as to what accommodation they could get for the money. In nine cases out of ten, promoters asked for a great deal more than could possibly be given them for the amount they had to spend. He was one of those who signed the memorial to the Institute, but he had some doubt as to whether he could conscientiously pledge himself to what the memorial proposed to pledge all who had signed it. Why he was doubtful on the point was that since the memorial had been signed, professional assessors *had* been employed in Competitions, but with, he was sorry to say, unsatisfactory results. Professional assessors, like all other architects, had their own idiosyncrasies and ideas, but they should not allow their own views to prejudice them against, or, at any rate, lead them to lightly pass over, a well-conceived and conscientiously-worked-out design, simply because it happened not to be in their favourite style. There was one other matter in connexion with Competitions to which he should like to make reference, namely, the conditions generally laid down as to premiums. In nine cases out of ten it was coolly set forth that, supposing the architect who obtained the first premium were appointed to carry out the work, the amount of the premium would "merge" in the commission. That was a ridiculously unfair proposition. Why should the man who was successful in the Competition be mulct of the premium if appointed to carry out the work? In that case he had to prepare new

plans and working drawings. Either the stipulation in question should be abolished altogether, or premiums should be abolished.

THOMAS PORTER, *Fellow*, said that, even at the risk of being thought to take a very commercial view of the question of the cost of Competition work to the architectural profession, he could not help saying that he thought Mr. Page was putting the case very unfairly when he urged that the labours of young architects in Competition work were to be valued at little or nothing. It was true that there was a surprizing difference in the stated cost of Competition drawings. For instance, in the archives of the Institute it was recorded that the drawings sent in in competition by an eminent architect for a building to cost over 700,000*l.* only cost the competitor 10*l.*—a statement that was certainly beyond his (the speaker's) comprehension. While on the other hand, in the case of the Competition for another important public building, in which the competitors were allowed 700*l.* each for their expenses, he believed that some of them spent the whole sum in preparing their drawings. With regard to the recent Liverpool School of Art Competition, a building to cost 10,000, he found that the Competition drawings must have cost at least 1,500*l.*, so that, as the commission on the work would amount to about 500*l.*, at least 1,000*l*, was lost to the profession by the transaction.

THE CHAIRMAN said that possibly reform in the matter of Architectural Competitions might be best promoted by means of a "Competition Society," of which each member should pledge himself not to compete except under certain rules and conditions. Such a society could seek to procure the appointment of professional assessors at the outset of a Competition, and could do other work which could not be effected through the organization of the Institute, nor through a confederation of the provincial societies.

Conference Fifth Meeting.

[Tuesday Evening, 10th May, 1881, Charles Barry, F.S.A., *Past President*, in the Chair.]

THE CHAIRMAN hoped that the Conference would be able to arrive at some general consensus of opinion on the chief points which naturally arose out of the subject. The question of Competitions was a national one, and, perhaps, some of the salient difficulties and evils of the Competition system were more felt in the country than in London. The principal points which struck him, as demanding consideration, were, firstly, the insufficient, and often contradictory, nature of the Instructions issued to competing architects. Such Instructions were, more often than not, drawn up by men totally unfitted for the task, and, consequently, they abounded in pitfalls for the professional men who competed. He spoke very feelingly on the subject, from having been lately consulted in regard to a very important Competition, namely, that for the Glasgow Municipal Buildings. The chief difficulty in that case was that the Instructions, both by plan and by specifying the height of the proposed building, absolutely defined its cubical capacity for the accommodation required, irrespective of such extra ornamental features as towers, domes, roof positions, and the like. The promoters then proceeded to name the sum the building was to cost. They practically asked for an expensive building, although they were pleased to say that they did not include decorations, and they expected to get it at 7½d. per foot cube! which was the result of dividing the stipulated cost by the stipulated cube bulk. No wonder that the Competition was a failure, and that it had been necessary to initiate a new Competition. Happily for the prospects of success of the new Competition, some good angel had whispered to the Town Council that they might get good advice from the Institute. That advice had been sought, and the Council had made the recommendations which had already been mentioned in the course of the discussion. So much with regard to the conditions of Competitions. With regard to the unfairness in adjudication, where no professional assessor was called in, opportunity was given for all kinds of favouritism. No doubt the decision of the assessor ought to be binding on the promoters, but it would be difficult to secure that it should be so in all cases. The obvious difficulty was that the persons who found the money for the work, or had the control of the money, did not like altogether to abdicate the power of the purse, and were unlikely to absolutely surrender their judgment into the hands of any architect, however eminent and trustworthy he might be. As yet, architects were not quite regarded by the public with the same implicit confidence as doctors were in cases of illness, and as lawyers were in cases of difficulty. Another important question was that of premiums. The prevailing practice of offering premiums to competitors seemed to him to be absolutely vicious from every possible point of view. It was vicious as regarded the competitors, because the premiums became the prizes, or the seeming prizes, in a lottery, with all the attendant evils of the lottery system. But the system was much more mischievous in its effects upon the promoters, for they were led to think that, in offering premiums, they were affording some very great

attraction to competitors, and they imbibed the erroneous notion that, instead of they themselves being the parties benefited by a Competition, they were benefiting the profession. He therefore thought it was desirable to abolish the system of premiums altogether, and that instead of the premium system some system of remunerating each competitor should be adopted—to do which it was obvious that the number of competitors must be limited from the first, or by selection in a preliminary Competition. In devizing a scheme for the regulation of Competitions, the Conference would not need to be reminded that the precise conditions applicable to the generality of small Competitions would not be applicable in the cases of Competitions for buildings of first-rate magnitude and importance. Touching the question of large Competitions, he might add to what he had already said about the Glasgow Municipal Buildings that the committee of the Town Council, charged with the consideration of the matter, had come to a resolution recommending the municipality to adopt the recommendations of the Institute with regard to the new Competition. If the municipality of Glasgow acted upon the recommendations of its committee, and of the Institute, a most important and valuable precedent would be laid down for the consideration and imitation of future promoters of Competitions. Whatever results the Conference might arrive at, in supplementing the General Regulations for the conduct of Architectural Competitions formulated by the Institute in 1872, it would be important that those results should be made as widely known as possible among public bodies and promoters of Competitions generally, and he had no doubt that Members of the Institute residing and practising in different parts of the country would take upon themselves the duties of local correspondents in permanent official communication with the Institute, advising the Council of any contemplated Competition before the conditions were absolutely settled, so that the Institute might be able to offer its assistance to the promoters by suggesting proper conditions of Competition, and making known in their localities the advice the Institute could so beneficially offer.

EDWARD G. BRUTON, *Fellow*, approved of the suggestion that non-metropolitan Members of the Institute should put themselves into communication with the Council when Competitions were mooted. A Competition had lately taken place, in the neighbourhood of Oxford, of a somewhat remarkable character. A cemetery being wanted, the authorities invited architects to send in plans for the lodge and chapels. The sum proposed to be expended on the buildings was £500, and the premium offered for the best design was £10. They received some seventy or eighty designs in response to their wretched offer. The successful competitor was not invited to make working drawings, but tenders were invited on the Competition design which won the premium, and that of a local builder, amounting to £510, was accepted, the work to be carried out without any specification. Subsequently the author of the selected design was invited to prepare working drawings without any further remuneration. The last Competition in which he (the speaker) indulged was that for the Municipal Buildings at Leicester, but he had never been able to get repaid to him the sum which every intending competitor had, by the terms of the advertizement, to pay for the plans of the site, although the advertizement promised that that would be done.

JOHN HONEYMAN, President of the Glasgow Institute of Architects, *Member of Council*, thought that the Competition for the Glasgow Municipal Buildings was very instructive in many ways. The Lord Provost and Corporation of Glasgow had not only consulted the Royal Institute of British Architects, but the local Glasgow Institute of Architects, which latter body had tendered almost precisely the same advice as that contained in the recommendations of the Council of the Institute already quoted. That advice was given by the two bodies concurrently and without communication with each other, and no doubt would, in consequence, duly impress itself upon the municipality of Glasgow as an authoritative representation of architectural opinion on the matter. The only additional suggestion which the Glasgow Institute made, beyond those put forward by the Royal Institute, was that the practice on the part of the competitors of sending about photographs and circulars to members of the corporation should be strongly discouraged, and he was pleased to observe that it was stated in the new conditions of Competition that that sort of thing would be strictly prohibited. It should, however, be remembered that such a scheme was not applicable to such small Competitions as had been referred to by Mr. Bruton. It was not to be wondered at that the outside public thought that Competitions were a benefit to the profession, for a very large number of the members of the profession thought so too, and he felt that it would be very difficult to eradicate the notion from their minds. Promoters would naturally do what they could to make the best bargain for themselves by offering premiums as small in amount as possible, or none at all, if they had reason to believe that a sufficient number of architects would think it a benefit to compete. The Competition mentioned by Mr. Bruton showed to what depths some members of the profession were ready to go. Seeing, however, that so many of the younger members of the profession thought that Competition under fairly reasonable conditions was a good thing, he was afraid that it would hardly do for the Institute to recommend that there should be no premiums offered by promoters. Undoubtedly, as the

chairman had pointed out, the difficulty was how to give effect to the conclusions at which the Conference might arrive. In the case of small Competitions, it seemed almost utopian to expect any result to follow the deliberations of the Conference. They might secure united action on the part of the better class of architects, but when one remembered what an enormous number of practitioners there were in the country, connected neither with the Institute nor any other professional association, one could not help being impressed with the fact that the better class of architects were in a terrible minority, and therefore, in this matter of small Competitions, powerless.

JAMES FOWLER, *Fellow*, said that he was not much in the way of Competitions, but he cordially endorsed what had been said as to the necessity of having professional assessors in all Competitions, and he thought that promoters should be bound to accept, and in all cases act upon, the decision of the assessor. It was necessary that the profession should take more united action than it hitherto had done to secure uniformity of practice, as far as possible, and to discourage canvassing and other dishonourable practices.

ALFRED WATERHOUSE, A.R.A., *Member of Council*, said that having been frequently engaged in Competitions as an assessor, many matters had impressed him from time to time as needing reform. It had often struck him that the Instructions to Competitors were a great deal too full, some binding the competitors too closely, others leading them astray. The most common mistake made by promoters was to ask for a great deal more accommodation than the sum which the promoters mentioned would allow them to have. That evil, he thought, might be met by not naming the cost in the Instructions, and by inserting a clause to the effect that the question of cost would be taken into consideration in examining the designs. One great advantage to be gained, in getting rid of premiums, would be to drive it home to the comprehension of promoters that the profession did not care for their premiums, but that it did care for their work. Another thing that had struck him was that competitors often took a wrong course by sending in alternative designs. The trouble which such alternative designs gave to the assessor was enormous, and there could be no doubt that the practice, in a great many instances, operated very much to the detriment of the competitor who resorted to it, as showing that he was not altogether clear in his own mind as to the best course. It was a very general thing now to make the drawings in pen and ink, but he believed that promoters would much better understand perspective drawings that were properly coloured. Architects had to do with colour, and it was their business to understand it and to be able to harmoniously arrange it. An architect might very often prove himself to be a man who understood colour and its use by his drawings; but, on the other hand, he had seen perspectives so coloured as to make it very doubtful whether their authors would not produce some very dreadful results if coloured materials entered into the composition of their buildings. Then, again, the question of morality entered into the subject of Competition drawings. Many architects, who would of course refuse to speak an untruth with their tongues, did not hesitate to let their pencils run wild, for many a dome went up 30 feet or 40 feet higher in a Competition perspective drawing than the section showed it to be capable of rising.

JAMES BROOKS, *Member of Council*, said that, in his opinion, Competition perspective drawings of any kind were a superfluity, and were very often so fallacious as to misguide not only the promoters, but the people who contrived them. He was perfectly certain that Competitions could not be done away with, and he should be the last, for the sake of the younger men in the profession, to discourage them. He thought, on the contrary, that Competitions were to be encouraged if they could be decided on fair, honest principles. Competitions were a means of affording opportunities to young architects of thinking out and designing something for themselves after office-hours; but as at present conducted they were a scandal, and he thought it was the duty of the Institute and the Conference to do their utmost to put them on a better footing. He was glad to hear of the advice which had been tendered by the Institute to the Glasgow Corporation; for he thought that the circulation of the recommendations of the Institute would be of great benefit to the public and the profession. Both would be gainers if Architectural Competitions were decided upon a fair and honest basis.

PROFESSOR KERR, *Fellow*, said that he had stated his views at the previous meeting, but he had listened with great nterest to the further discussion, and thought the tendency of opinion was clear and sensible. He held, as the result of somewhat mature deliberation during the last few years, that if Competitions could be made commercially sound, they would be capable of conferring great benefit on the public at large. He could not say that he attributed quite so much importance to the interests, or the fancied interests, of young men, as some of the speakers did. He was accustomed to think that young architects were best started in business upon works of an unpretending character. He had no objection to young men having a fair chance of advancement if they thought they could get it by entering upon some of the smaller Competitions, but they should be discouraged from entering upon large Competitions, which could only lead to expense and

disappointment. If the Competition system had any good in it, why should it not be, not merely tolerated, but directly encouraged by the profession? Let the system be put upon something like a commercial basis, and let competing architects have not only fair play, but something like reasonable payment for their services. If they went before the public and said they wanted to turn each other out of their connections, the public would say, "Very well, we will let you do it, but you must do it at your own expense." As to what would be reasonable remuneration for competitors, his own impression was that from two to two and a half per cent., divided equally amongst a considerable number of competitors, would be sufficient, and he should be very much surprized to find that, in ordinary cases, the public would object to pay that. Of course, in such a Competition as that at Glasgow, competitors could not expect to get so much, but he thought in that case one per cent. would not be too much to give. He was very glad to see the support that was given to the proposal to abolish premiums, for the practice of offering them, and of competing for them, was essentially pernicious, and indeed savoured of gambling. If the promoters of a Competition spent £100. or £150. in premiums, they thought they were doing wonders; but the main thing they were doing consisted in demoralizing and debauching the minds of the competitors. If the Conference could come to some distinct resolutions on the subject, the Council would be greatly aided in their consideration of it and would find their hands strengthened. He might state that certain draft resolutions had been prepared since the morning's sitting, which he hoped might be found suitable as a basis whereon to arrive at the definite opinions of the present meeting.

*** The Chairman, at the close of the meeting, put a series of eleven resolutions, which were carried *nem. con.* These, which were to be submitted to the Council of the Institute, will be found at page 259 of the Journal of PROCEEDINGS, 1880-81.

Conference Sixth Meeting.

MURAL PAINTING AND COLOURED DECORATION.

THE GAMBIER PARRY PROCESS. By Mr. FORD MADOX BROWN.

[Thursday Evening, 12th May, 1881, George Edmund Street, R.A., *President,* in the Chair.]

Mr. President.—My experience of mural painting is not very great, nor of long standing. Three moderate-sized panels are all that I can boast of in this direction. I began the actual painting of them little more than two years ago; but I may say that I have been thinking on the subject all my life, and I consider it one of too great importance to the country, at present, for me to wish to withhold from you what little I have learned about it. I will confine myself to the technical and practical side of the matter.

There are twelve panels to be painted in the large meeting-room where I am at work, in the Manchester Town Hall. Each panel is rather more than 10 feet long by somewhat less than 5 feet high, and they are not quite 5 feet from the ground. They are thus not very dissimilar from pictures on the line in an exhibition. Each panel has a window directly over it and one facing it. On fine days there is plenty of light, but in the short gloomy days of winter the paintings are best seen by gaslight, on festive occasions, when the hall is brilliantly illuminated. Some years elapsed before the present decorations were put in hand, or the method of painting them fixed on. At length, at my recommendation, that process (of Mr. Gambier Parry's invention) known as "spirit fresco" was selected. Meanwhile, however, the spaces had been filled in with a compound of lime and marble dust—fine and hard. Mr. Parry in his pamphlet, called "*Spirit Fresco Painting,*" recommends a stucco composed of two parts of pure river sand to one of well-slaked lime. I do not fancy the change of sand for

marble dust would have in itself caused much difference, had not the plasterer trowelled the surface far too smoothly—till it was like ivory, in fact. To remedy this I had the faces of the panels cut down with grit-stone; then, to increase the absorbency of the stucco, it was, before receiving the first preparation, well heated with a gas apparatus contrived for the purpose.

One of the distinctive features of Mr. Parry's invention, compared with the somewhat similar methods in use on the continent, seems to be this coating of the wall, before painting on it, with some of the same medium with which the colours are ground. This preparation, which should be applied not long before the actual painting is commenced, arrests, as I apprehend, the too great absorption of the medium out of the colours into the stucco, which might end otherwise, as with Leonardo's oil painting on plaster, in the total pulverization of the colours on the surface; also this medium, which consists of wax, copal and gum *élémi*, is after drying still susceptible, even for a considerable time, of re-solution by the spirit, or essence, of lavender, with which it is first compounded, so that the fresh colours laid on the surface are constantly re-moistening, and assimilating themselves to the medium already absorbed into the plaster, thus so to speak striking roots there.

In France and Germany, where a process, if not exactly identical with the Gambier Parry one, at least in a great measure analogous to it, is now superseding the old Italian fresco, they do not coat the wall first with medium—at least, so I am told. This is cheaper, but also less scientific; though when we consider the time which these works are expected to last, we should not be niggardly in their preparation. Years ago I tried my hand at two large specimens of Italian or *buon* fresco. They were destroyed, and I regret that I have not now got them to see how they might have stood. The surface of the old Italian fresco is very beautiful, with just that even semi-gloss which for a wall is so desirable, looking well from every point of view. The difficulties and hindrances in its execution, however, are such that I question if many who have once tasted the sweets of the Gambier Parry fresco would think of returning to the older one. Then there is a *sine quâ non* with regard to the painting of walls in this climate—in this smoke-bedimmed country—a consideration not to be overlooked, and expressed in the prudent housewife's inquiry, "Will it wash?" To my own experience, the Gambier Parry fresco will wash. I have tried soap and a nail-brush on a small specimen before beginning on the wall itself, and it looked as well after the operation as before. Italian fresco, whatever they may say, will not wash. The relative claims of stereochrome (water-glass) with Mr. Parry's method remain to be considered, but I will return to their consideration later.

Mr. Parry, I understand, can point to examples of his process of twenty-five years' standing in England. I have myself not long since inspected the French paintings, much in this style, by Hyppolite Flandrin in Saint Germain-des-Prés at Paris, and they did not seem to me much changed since the day when I first saw them, thirty-six years before.

As to the facilities for working the colours, and executing different textures and appearances in Mr. Parry's process, there seem to be practically no limits to them. Every proceeding that is applicable to oil, or watercolour, or fresco, is easy of attainment in this spirit fresco, and what is of great importance, every colour may be used in it. Depth of tone and brilliancy in the lights, the utmost transparency, with the height or very impudence of *impasto;* all varieties of glazing, scumbling, retouching or stippling; nothing seems to come amiss to it; and though certainly (as Sir Frederick Leighton has observed) if the portion in hand can be finished off at

once it will when dry look neater, as indeed is also the case in oil or watercolour, yet, as the drying process is never complete on the next day, the work can, if necessary, stand over till then. This, at least, is the charming experience of the first five or six weeks' work. But after these are past, and the portions first painted have commenced drying in earnest, then a further experience is gained, and the one quality, which more than any other quality, becomes a desideratum in the work, is strength.

To paint strongly and warmly, and more than ever before, transparently in the shadows, proves, in fact, to be of most imperative necessity; for the colours after a certain duration of drying become cooler and lighter and more opaque, and ever as the months go on paler and more opaque, so that one cannot too resolutely grapple with this tendency. This is indeed one of the chief difficulties of the process, and one that at first caused me some discouragement, till I got into the way of meeting it. The other, and I am happy to say the only other, drawback that I have experienced, in this mode of painting, consists in the tendencies of several of the colours to dry in different degrees of glossiness. For instance, ivory black will dry perfectly dead compared with every other pigment on the palette. When you walk past your painting, as the opposite windows faintly reflect in the gentle gloss of its surface, every touch of ivory black tells out like a hole in the wall. Other colours have a tendency to shine too much. I communicated with Mr. Parry on the subject, but he does not seem to have noticed the objection, and as he has not seen my Manchester works, he may possibly have never yet scrutinized his process exactly facing a row of large windows. Now, the plan I have adopted to secure evenness of surface is that of touching the offending parts with a wax varnish, the instructions for making which are in a well-known treatise on painting. It is a recipe that I have stored in my memory for thirty-six years, and I should be much beholden to Mr. Parry if he will either sanction it or invent us a better one, and I cannot insist too much on the desirableness of wall painting being always uniform and beautiful in surface. With easel pictures it is different, for no one at all used to them would look at them from a wrong angle; but in spite of yourself you *must* view a mural painting from every angle and situation. Baron Leys, the great Antwerp painter, so well recognized this that in his decorations in the Town Hall of that city he employed water-glass for the wall facing the windows, though for the two end walls of the same room, as also for the decorations of his own dining-room, he used gutta-percha oil—something, it would seem, very like spirit fresco medium. There can be no doubt that water-glass properly used (not recklessly squirted on as our Maclise employed it, in the impatience of his great genius), forms the most beautiful and unbroken surface of any—not even excepting Italian fresco, where the necessary egg-retouching can always be detected; and stereochrome has this advantage over spirit fresco, that while the paint in that process grows gradually weaker, in water-glass the final aspersion, to use Maclise's own words, "*has the enhancing effect of the shower on the rose, dyeing its native hue of a deeper, richer tinge.*" But in Germany, the very country of its invention, water-glass seems to be now given up; so we must needs be content with our native process, and I for one feel nothing but gratitude to Mr. Gambier Parry for the years of labour he bestowed on his experiments, and the consequent advantage to art in this country.

Not to detain you much longer, I will conclude with a few observations, first as to the kind of wall spaces best fitted to receive paintings, and lastly on the choice of subjects suitable

for them. The idea of a picture being naturally a movable object, and one inclosed in a frame, is so wedged into and embedded in the English mind, that though here it may sound scarcely credible, I can assure you I have been asked more than once, by persons seeing me at work at Manchester, "where my picture was to be hung when finished." The fact was that the naturally recessed panels under each window, between the richly grouped vaulting-shafts on either side, suggested to the ordinary mind the pictures they were wont to see round rooms. Now, I do not for an instant mean to infer that such spaces are not naturally fitted to receive painting, but I would urge that they are not the only spaces fit to be painted, and that all spaces need not necessarily be sunken panels. To my mind, to complete the decoration of this great Hall it will ultimately be desirable to paint not only these twelve panels under the windows, but the vacant irregular spaces at the two ends of the room—one a magnificent arched space about 40 feet from the ground over the organ, the other a long irregular space over the two main entrances, and cut into by them. The idea of pictures round a room would then be done away with, and the mural decoration of the Hall perfected. I remember years ago a company of young artists so impressed with this principle that, in their enthusiasm for a set of spaces, high up out of sight, and each with a couple of circular windows cut in the middle of it, they volunteered to paint the whole set gratis—and did so! The best spaces for painting are such as have no immediate deep ledges to shade the edges of the composition—spaces of any shape that seem otherwise useless, and, if possible, spaces where the sun does not reach, for while I am at work at Manchester this same sun, decked in a little brief authority, fortunately very brief, plays such tricks with what I am painting as might make St. Luke himself weep. As to choice of subject, it cannot be too often impressed on those in authority that it should be left to the artist. A fine event morally or historically (let us say "the Peace of Utrecht") does not necessarily make a fine painting; on the contrary, "the Peace of Utrecht" can never, as a picture, be but a number of men assembled together in a room; and yet to get fine painting is the chief business. Then, again, if they will urge on the painter events requiring too many figures, it may prevent his doing justice to the work. He cannot render an Expulsion of the Danes in three lines, as Hogarth drew the soldier and his dog passing through a gate. One subject they would have wished me to paint at Manchester was the opening of the Town Hall itself, with the portraits of the eighty members of the council, and with a procession of 40,000 people, five miles long! On the other hand, the painter should himself be reasonable, and not too poetic in his imaginings. In fine, the subjects chosen for the great Hall are representative of the history of Manchester—from the time of the Romans to the present day.

THE COLOURED DECORATION OF PUBLIC AND PRIVATE BUILDINGS.

By Mr. John D. Crace.

Mr. President.—I have accepted the title suggested to me for my Paper, because it seemed to me a very good one, as calling attention to a distinction not always observed in decoration. I mean the distinction which should exist, in a greater or less degree, in the treatment of buildings according to their destined use, as well as according to their proportions

or character. There are of course distinctions which are pretty generally recognized between the treatments to be adopted, for instance, in buildings for religious service and those intended for secular uses. Beyond this, it is worth while, perhaps, to point out that what may be desirable in a private house is often unsuitable or inadequate in a public building, even where its proportions or character do not stamp it emphatically as such; and, similarly, that forms of decoration, best for interiors of which the use is more or less public, are often those which would be in questionable taste as well as inappropriate in a residence.

Apart from the mere question of scale or proportion there are several reasons for keeping this distinction in mind. One, not unimportant, is this: in the decoration of an interior for private occupation we have always to consider that the decoration, so-called, is only one element of the ultimate result in colouring and effect. It must be such as to accord with furniture, draperies, carpets and other prominent accessories; all of which, as well as the painted decoration, must be so regulated in colouring and design as to admit of that last touch which comes of habitual occupation, and which is generally destined to improve, or mar, all that goes before. It is moreover to be considered that features of decoration, agreeable enough when we regard them but occasionally, may be intolerable as constant companions. Now, on the contrary, in public buildings or in rooms for public use, the decorator must provide such colouring that no after treatment is necessary to its completion. He knows beforehand—or should know—to what uses the place will be put; and must so provide that no lack shall be felt when it is so in use. As a rule, all such accessories as drapery or furniture are either wanting altogether, or play an unimportant part in the general scheme of colour. He must not allow the want to be felt. The colouring must be bolder and more complete in itself; and must seem most complete when the ordinary use of the room occurs. If such ordinary use involves the presence of a crowd of people in dark clothing, the fact should be borne in mind; or of a crowd in bright or delicate colours, provision for this must be made in the colouring—just as the probable use by daylight or artificial light must also be allowed for. Again, it must be remembered that the ordinary use of many public interiors is so intermittent, or occasional, that the effect to be produced in the mind must be produced rapidly. In such cases, we must not depend on that sort of interest which has a peculiar charm in a private residence, and by which, though but little affected on first entering a room, we are led step by step to admiration. There is probably no form of decoration so agreeable to persons of educated and refined taste as that which only presents itself at first as being "in good taste," but which subsequently reveals latent beauties of detail and harmony. And as I have used that much abused expression "in good taste," let me pause one moment to give it a definition. Tastes may vary infinitely, but the almost indefinable quality which we indicate by the words "good taste" I take to mean "refined good sense." This is very different from "public taste." Much also will of course depend upon the purpose of the room or building when the character and tone of the decoration is to be decided. These must be sympathetic with the room's use in any case; but if that use be a public one, a greater breadth of effect should be sought, a greater gravity of expression if the use be grave, a more obvious gaiety if the use be festal, than would be called for in private rooms. This breadth of effect is by no means incompatible with the most elaborate detail; it requires that the detail shall never overmaster the expression of the main lines and features, nor disturb the repose. Many of you may be able to call to

mind examples of decoration which are full of clever detail, but in which all is confusion. Strong colours are dotted about in patches, possibly harmonious, but without any constant or intelligible aim. Now this may occasionally be done in a private residence with happy effect, a sort of colourist's sport. I do not advocate it, but I admit the possibility of its being agreeable. In a public building any such treatment should be absolutely proscribed. In the former case you may assume the indulgence of an individual fancy; in the latter you are acting as one of a community, and must treat the community with respect, observing order and system. The more dignified the purposes to which the interior is devoted, the more carefully should the decoration be controlled by some system, and have its objects clearly expressed.

Let me define the proper aims of decoration, namely:—1. To express or emphasize the best forms and proportions of the structure; 2. In the absence of structural expression architecturally, to compensate for that absence; 3. In some cases to correct proportions which, from whatever cause, appear unsatisfactory; 4. To explain surfaces and contours; 5. To add interest of detail or richness of effect.

Now although transcendental power in the artist may excuse, perhaps more than excuse, the want of strict adherence to these legitimate aims, the disregard of them will always add enormously to the difficulties of the boldest and most skilful; nor need we consider that on which genius of the first order can alone venture. The power of the artist may, in some cases, compel us to forgive, and almost to admire, the breach of laws founded on good sense; but even our enthusiasm will usually allow that their disregard has not really been a gain, even to genius. Speaking before architects, I do not hesitate to express a belief that the most splendid exceptions (such as, for instance, the Sistine Chapel) really prove the rule, and that some expression of structural lines would have been a clear gain to the work. In dealing then with any interior, let the decorator first put to himself these questions:—1. Has it constructive features clearly expressed, and do they, whatever they be, lend themselves to a satisfactory explanation of good proportions? 2. Do the conditions of light, perspective, or other outward circumstances, make it desirable to give additional force to this expression; do the features themselves lack strength, and therefore need support; or, on the other hand, are they somewhat heavy, and therefore need reduction or subduing? for either remedy is possible if the colourist knows his art. 3. Or again, are there no structural features to deal with? Is there an absence or insufficiency of moulded surface, so disposed as to assist the eye in its instructive search for structural lines? then the decorator must seek a method of supplying the want, not necessarily by substituting colour for mouldings, where mouldings might have been, but by providing paths or stepping-stones, by which the eye may traverse the surface pleasantly, willingly, by such routes as to discover for itself those charms of proportion, of harmony and of art, which may be there.

Having been able, we will suppose, to answer the first question affirmatively, that is to say having found constructive features well explaining the good proportion of the interior, the colourist will take care that all he does shall carefully preserve those features, and keep them well in the mind of the spectator. Should they run a risk of escaping attention, either by reason of want of light, or through the presence of other attractions for the eye, he will duly emphasize them by placing them in sufficient contrast to the intervening spaces; and this not necessarily by brilliancy of colour but by attention to the distribution of light and dark. It

will usually be desirable to keep the same apparent force of relief throughout these features, increasing the emphasis where the circumstances tend to allow of the eye wandering at random. If, however, the constructive features appear poor or inadequate, colour affords the means, in many cases, of restoring to them much of the desired breadth or vigour. We often find in buildings erected at a time when the use of colour was a matter of course, that many of the leading constructive lines would appear thoroughly poor and insufficient if unassisted by colour. I need only mention the ribs of the vaulting of the early Italian churches. In the majority of instances these consist of a single roll, or chamfered square, dividing the whole bay into four parts, if the area be rectangular, or in the simplest available way, if polygonal. They are made sufficient by the painted borders which support them on either side, and connect them so intimately with the pictorial or other coloured decoration of the spaces, that the two appear thoroughly a part of the same scheme. It will be observed that if the proportion of rib to panel be inadequate, the border is coloured with some decision, or toned to accord with the rib; but if the rib be adequate, the tones of the border are permitted to ally themselves with the decoration of the panel or space.

Coming to the third question, namely, the absence of structural emphasis by moulded surface, when coloured decoration is to be a leading feature of an interior, moulded surface may be, to a very large extent, dispensed with; and it may fairly be said that the fewer and simpler the mouldings the better will they bear treatment in colour. Where "mosaic" alone is used for the internal decoration, the finest examples are totally without mouldings. Their place is taken by coloured borders, so defined as to serve the same purpose. In order to admit of these being used where they are, in fact, indispensable, all the arrises are moulded off, and this rounding has the advantage of insuring some play of light on the gold.

The treatment of gold grounds, whether in mosaic or not, is a matter demanding considerable care. The great value of gold in decoration is its sympathetic quality. More than any colour, it is sensitive to the influence of adjoining colours, and it is this which makes it so valuable an adjunct to coloured decoration. A red or warm outline or border will impart a warmth to the whole gold ground; whereas, if the border be black or cold in tone, the gold is chilled and lowered in tone throughout. To this quality must be added that of reflecting softly, and with a subdued warmth of tone, the colouring of the room and its accessories—thus imperceptibly blending part with part. It is well known, among all practical decorators, that it is far easier to bring colours into harmony where gold is used than where it is absent. The fact is that, by reflection, it imports fragments of the colour of one part of the decoration into the midst of some other portion of the general colouring, in such a way, and with such modulation and variety, as to afford the most valuable of all means for what is known as "recall" of colours, an indispensable part of any pictorial or decorative scheme. And it does this with so much play of light and dark, that it excites the same sort of interest as that which we experience in watching the changes of colour on the sea, as the clouds pass over.

Reverting again to the question of proportional structure, and the colourists dealing therewith: there are numerous cases in which the interior has either by intention, by want of means, or other circumstance, been left with its leading features too cumbrous, too bold, or simply too plain, for the size or character of the whole. In some cases it will be necessary to consider how to deal with the coloured ornamentations so as to somewhat repress the excess

of such features. This may generally be done by keeping the depth of colour more nearly that of the intermediate surfaces than would be the case if expression were the object. Thus, if we suppose a ceiling to be divided into small blue panels, by very wide beams or margins, the effect will not be unpleasant if the beams are of brown wood; but should they be of some white tone, the disproportion would be at once painfully apparent. Precisely the same case often arises with the proportions of doors and their architraves, dados, cornices, and other features of ordinary rooms. Where a room is of full height, its cornice may often advantageously partake of the colouring of the ceiling in point of strength; but if the room be low, every means must be taken to make it a part of the wall, by keeping its colouring allied to the wall rather than to the ceiling, lest the eye be stopped before it has surmounted the cornice. In this latter case, the strongest contrast must be placed as high up in the cornice as there is any convenient place for it. In some cases it is possible to continue the same strength of colour on to the ceiling itself, and so to avoid any sharp demarcation.

The ornamentation is no less important than the colouring, when dealiag with proportion, and its distribution is a matter of at least as nice judgment. It is quite possible to disturb the sense of simplicity by a very small amount of ornament; as it is also possible to retain the effect of simplicity even where ornament has been freely used. When but little ornament is used, it should be strictly confined to those points or lines which it is desirable should be noticed. The ornament will then help to decide the impression of "scale" in relation to the whole interior. If too small, it will produce a sense of feebleness; if too large and unbroken it will give a sense of coarseness. It may be taken as a rule that the less of ornament there is, the more important it is that its position, form and proportion be carefully studied.

I have spoken of ornament looking coarse. Yet it is quite possible to make use of large and bold forms of ornament on spaces of very moderate dimensions. The coarse effect may be avoided by having a secondary finer ornament drawn within, or interlaced with, the larger forms. The finer line must be the one to break into complications of movement and curve. It never answers to make very thick and heavy lines break into very lively or elaborate contortions. There is something of the dancing elephant about such ornament. Where breadth and substance of line are used, the movement must be in dignified and measured curves, or in forms capable of geometrical analysis; whilst the lighter lines perform within or around them, with a freer and less tramelled gaiety.

So far we have been dealing with general principles. I propose to devote the remaining time at my disposal to the consideration of practical treatment; especially when applied to the interior of buildings having defined uses. In speaking of the decoration of churches I propose, for the sake of brevity and simplicity, to omit all mention of those of "gothic" character, and to confine my remarks to those which, because less attractive to many of us, deserve some careful thought as to how they may be rendered more harmonious to their use, and more in sympathy with the religious side of our minds and senses. Dignity, harmony, repose, are the first qualities we seek in the interior devoted to religious worship, whether it be large or small. The last-named quality, that of repose, can be best secured by a firm and undisturbed expression of the leading forms of the structure. The mind is thus quickly set at rest, and relieved from that "instinctive search" for structural expression of which I have before spoken. However lavish the ornament, it must not interfere with this first requirement.

As to dignity of colouring, it is perhaps more difficult of definition. It may be attained by light and simple tones if the building have already noble features; but it often happens that these are insufficient, or imperfect; or that the light is too diffused to afford any of those effects which arouse our sense of interest. Then a bold colouring, if skilfully handled, is of great value. Rich, and tolerably pure, reds, warm greens and browns, blues carefully modulated, and the mellowing gold with its explanatory lights and rich reflections, are among the hues which first present themselves; nor must we forget those touchstones of colours, black and white, indispensable, the one to purify, the other to intensify the colours employed. Tints of any of the poorer colours, that is to say pure colours having a large admixture of white, are inadmissable. Indeed I would say of the interior of places of worship, that the lighter the hue, the less pure or the more subdued must be the tone.

The use of pictorial art, and of stained glass, will each suggest some restrictions, or modifications in the colouring. The employment of both together has often been deprecated; but I confess that I can call to mind many a building containing both, from which I should be sorry indeed to exclude either. I would suggest, however, some attention to the following rules, where both are used, namely:—1. The relative positions of stained glass and picture should be such that the tinted rays of sunlight would never, or rarely, fall directly on the painting; 2. There should be a free use of white with the coloured glass; 3. The paintings should be pure in tone, and simple and expressive in drawing.

The conditions which are offered to the colourist by places of amusement are of a totally different kind. We frequent them to shake off our cares, our dignities, and the daily rule of life, and desire that the little world then around us, and ourselves, shall look happy, pleasant and free from care. Not only, therefore, must the place in which we meet look cheerful, but we ourselves must look pleasant, especially that majority who have "complexions," and are "dressed." A great deal has been said and written about the colouring of theatres; but so far as colouring goes, the theorists, when they have differed from accepted practice founded on experience, have been wrong. Chevreul goes into the question in detail, and proves to his own satisfaction that crimson is a bad colour for the interior of the boxes, as tending to give the complexion a tinge of the complementary green. He advocates a pale green, therefore, for the interior of the boxes, as enhancing the rose tints of the complexion. He thinks that the fronts of the boxes have a much more remote effect in this respect, but that the cushions should be covered in green velvet. Now here experience tells us that he is absolutely wrong from first to last; as he is, indeed, constantly wrong when he is discussing the effects of colour on complexion. In this very matter, he appeals to results of experiments made on flat surfaces with uniform tints; and he is, therefore, in no position to judge of effects in which one colour is in deep shadow, another in strong light, the object to be influenced being a quite uncertain quantity as to depth of complexion, colour of costume, and degree of shade. Green lining to the boxes, and particularly green cushions in the front, would be fatal to four out of five complexions and costumes. There is no colour at all equal to red, and especially red in shadow, for setting off to advantage a variety of complexions and costumes. The too red complexion is toned down by contrast; the pale borrows colour by sympathy, a very important factor where the human face is concerned. Besides this, the shadows are all warmed by reflection, and it is cold shadows, not cool lights, which are detrimental to a face.

Then Chevreul underrates the value of the box fronts as colour; the arguments which he brings to bear on the interior are really applicable to these. Consequently, a light colour, which shall not be either so light or so pure as to injure, by contrast, the whites of the costumes, and which shall yet set forth the colouring of the faces which are in the same plane, will be found best. This may be relieved by gilding, and by neutral tints, or coloured ornament sufficiently broken up to afford only a neutral result—a soft and light contrast to the darker interior.

For rooms devoted to music or dancing, the conditions of colouring are not so similar to those for theatres as might at first appear. In the theatre, the lighting of the audience is direct, the background being in shadow. In the ball-room or concert-room the light is to a great extent reflected from the walls, and will partake more or less of their tone, unless the sources of light are distributed pretty equally around the walls themselves. In a room hung with green silk, for instance, and lighted only, or mainly, by a central chandelier, all that side of the face, which is in shade from the chandelier, will be tinged with the green light reflected from the walls. It is, therefore, always desirable to distribute the sources of light, both to obviate these reflected tints and to diminish all shadow. It is also very desirable to employ such tones of colour as readily reflect light, and light rather warm than cold. It must, however, be remembered that many of the tints which are best for this, such as rather pure pale buffs, are apt to be very trying to portions of the costume, especially to whites of transparent material, such as laces or gauzey fabrics, which against them become smoky in tone. A large preponderance of white (not too raw) with a liberal use of gilding, and some red (as drapery or otherwise), for the gilding to reflect, are always good. Probably no background is so effective for a ballroom as tapestry in pale tones of fairly pure colour, which the texture of the fabric always softens below the colouring of the complexions or dresses; but in a public room, so costly a decoration can rarely be expected. The beautiful variations of quiet tints, exhibited by natural marbles, are again admirable. If the cost allowed of it, I would desire nothing better than to have the lower walls, to a height of some six or seven feet, lined with various marbles, and the upper walls in subdued white, relieved with gilding, and divided at intervals with pilasters of coloured marble. The draperies, portières, &c., should in this case be of rich and deep colours. This again, however, is a costly decoration, and we should consider what is possible with moderate means. Very grey tones of green, broken up by soft white, and set off by reds in the draperies, are becoming, if the lighting is well distributed. The whites, in this case, may either be softened by tinting, or by some form of delicate arabesque ornament, in mixed colouring painted thereon. The reds of the draperies must of course be recalled, in somewhat reduced tone, in the decorations, either as margins, lines or medallions, or by any appropriate means. If the proportions permit, a good system of decoration for a concert-room would be one by which the colour, intended as background to the company, would be carried only high enough to serve that purpose; and the larger surfaces of wall, from which light would be reflected, would be kept in light and somewhat warm tones.

In the case of smaller rooms used for similar purposes (only occasionally) in private houses, the great point to attend to is the even distribution of light. A wall with some depth of colour, if not too gay, may be made a very effective background. But care must be taken in that case, to light up the company and not so much the walls. For a dinner party, a dark wall relieved with pictures is much the most effective and becoming, because, the table being

well lighted, the faces are all well lit; the reflection from the white cloth prevents all heavy shadows on the features, and the dark background purifies the tones of the complexion. Moreover the alternation of the black coats of the men performs the same service with very great advantage to the ladies at table.

The colouring of the galleries in museums, whether for the exhibition of pictures, sculpture or miscellaneous objects, is a very large subject, and I will only briefly allude to a few of the main points to be considered. For pictures, which of course vary greatly in tone, and each contain a complex arrangement of graduated colour, there is no background equal to red. This must be neither too subdued nor too dark, if the pictures be hung near together; but where much space is left between the pictures, a duller tone may be preferred. Marbles are excellent for the architectural features, and gilding also, if confined to structural lines. All whites must be lowered, for if too crude they diminish the light in the pictures. Bronze is very useful in the accessories.

The colouring thus indicated is likewise adapted for sculpture, though some modifications may suggest themselves. Chevreul fell into the same error about sculpture galleries that he did about theatres; and for the same reason. He forgot to take into account the secondary light, which is that found in the shades. He thought that, by painting the walls blue-grey, or green, the statues would assume the warm tints of the complementaries of those colours. This would be true if the white forms of the statues were flat bas-reliefs in the same plane as the walls, or rather if there were only one wall. But it must be remembered that we are dealing with spaces surrounded by walls, and that light, partaking of their colour, is being reflected from all of them. And the more diffused the light, the greater the effect of the secondary, or reflected, light which is found in the shades. This secondary light always partakes of the complementary of the direct or primary light; consequently green or bluish walls will inevitably impart a cold or green tone to the half tints and shadows. On the other hand, where a statue is well lighted, a background of dark green foliage, which is behind it only, is admirable. Or if the walls surrounding a statue be of warm tone, a limited background of a deep warm green may be made effective. Two other items of a sculpture gallery must be considered—the floor, and the pedestals or bases on which the statues are placed. The floor may be white, or white and black, if the walls be of warm and full colour; but, if the walls be pale, the floor may advantageously be of a dark warm tone, such as maroon or rich brown. In the latter case, the pedestals may be of some green tone, for the statues will derive some advantage in the direction of the complementary. If the walls be red, a grey marble makes the more satisfactory pedestal, or at least a marble containing much grey. In these observations I have throughout considered especially modern sculpture. Antique marbles have usually acquired so much warmth of tone, as to make it less important to enhance that quality.

In a museum of miscellaneous objects, or of natural specimens, we come to an entirely different set of conditions. Objects of this kind are for the most part in cases inclosed with glass, and the backs of these cases may be coloured to suit the contents of each. For such objects as china or jewellery, dark colours will be preferable; for bronzes or dark pottery, grey is suitable, whilst for such objects as specimens of Natural History, stuffed birds, fossils, or objects possessing many varieties of colouring, a pale grey tint is best. I observe that this

tint has been selected for the cases in the New Museum of Natural History; and I am glad to take this opportunity to congratulate the distinguished and talented architect of that fine building on the excellent effect of the painted decoration of the interior, which has been treated harmoniously and with judicious reserve.

On the general decoration of such galleries, above the line of the inclosed cases, I am not disposed to place hard and fast restrictions. Nothing could certainly be less desirable than vast expanses of white, and the many varieties of natural woods, afford, as it seems to me, one very agreeable and suitable field of choice. In any case the good sense of the true architect will keep him within the limits of what is fitting and appropriate.

FRANCIS C. PENROSE, M.A., *Past Vice-President*, concurred in many of the remarks of Mr. Crace, who advocated reserve in the treatment of colour, especially of important public buildings. But the chief subject he (the speaker) wished to bring before the meeting was another claimant for durability in art. The inventor was Mr. Noy Wilkins, a landscape painter, and also the author of several works. Rather more than two years ago he (the speaker) gave an account, at a meeting of the Institute, of the method in question, and a few days ago Mr. Wilkins provided him with a specimen of the process. It was a piece of Bath stone, covered with "oil fresco," as the inventor called it. It was painted with a choice of mineral colours which, mixed with linseed oil prepared in a certain way, did not enhance the cost of the oil beyond a few pence per gallon. The oil dried very rapidly, and it could be made to dry either fast or slow, which was consequently of great value to painters. The material used was entirely mineral, and there was no lead employed, so that those using it were free from the danger of lead poisoning. The colours would, he believed, be of a permanent character, as there was nothing in them to decay, for no sulphureted hydrogen would have any effect upon them; and they could be produced flat, or with a gloss upon them, at pleasure.

ALFRED WATERHOUSE, A.R.A., *Member of Council*, said that he had watched Mr. Madox Brown's labours at the Manchester Town Hall with great interest, and with very strong approval, for Mr. Madox Brown had made a great success in Manchester with his pictures; but it was a matter of much regret that he was not more amply remunerated for the work. Nobody expected, when the arrangement was entered into, that these pictures would involve the immense amount of thought and labour which Mr. Madox Brown had expended upon them. Towards the close of his Paper, he mentioned that in Germany water-glass had been given up, but in the Low Countries, both at Courtrai and Ypres, he (the speaker) certainly saw some which led him to the belief that it was very successful. The surface was perfectly dead and was very admirable, but he did not wish to make any comparison between it and the Gambier Parry process, for both systems seemed to be very excellent.

MR. J. G. CRACE said that it might interest the Conference if he recalled to the remembrance of the Institute some remarks* he made before it exactly thirty years ago, after he had been to Munich to study the fresco painting going on there. Through the kindness of Lord Erskine, he obtained an interview with Herr Kaulbach, and received from him the following particulars of the composition he was using for his pictures, namely, 1½ lb. wax, 3½ lb.

* See Mr. J. G. Crace's Paper on *The Decoration of some of the Buildings at Munich* in the TRANSACTIONS, 1850-51.

gum damar, and 5 lb. turpentine. These were properly mixed together and boiled until the substance became of a uniform consistency. The ground of the surface to be painted upon was simply, as far as he could understand, one of plaster, sufficiently porous for the substance (which was merely a vehicle for the colours) to sink into the ground. It seemed to him, from what he saw of it, that the medium was a very successful one. The colours were exceedingly agreeable, and the process seemed to offer many of the advantages of fresco painting without the disadvantages. The time elapsed since he made those observations was so long that the experiment must now have been fairly tried. How the paintings which he saw in progress looked now he did not know. He referred to those in the hall of the grand museum. There was one disadvantage in all encaustic painting, for it contained wax, and wax, if once soiled, could never be cleaned, as experiment with a common wax candle would show. That could not fail to be a serious objection to encaustic paintings where they were likely to get soiled. After his return from Germany, at the time mentioned, he used wax as a medium for decorative works very extensively, but had to abandon it, for he soon found that it would not clean, and that any attempt to clean it produced a smear. He mentioned that as a caution against the employment of the wax process in smoky towns. With regard to frescoes, it was his conviction that frescoes would certainly never do in smoky towns, for the lime was too absorbent of carbon, and was difficult to be cleansed without damage.

A. K. MACKINNON, M.Inst.C.E., *Fellow*, said that, in South America, a species of fresco painting was employed with very successful results. He did not agree with Mr. Crace in thinking that fresco painting was unsuitable for this climate. Fresco painting, produced by the process which he was about to describe, was used in South America in smoky rooms, and was easily cleaned. The lime was first of all prepared from the finest white chalk (Carrara marble would be a better material where it could be procured), being thoroughly well burned. It was afterwards slaked and made into a cream in shallow tanks. The cream was allowed to deposit, and in the course of a few days the whole of the lime was so deposited. After the lapse of two or three days, it could be cut up into pieces; it was then snowy-white. When it was desired to use it, it was mixed with a certain proportion of water, and floated on to the wall to be treated, generally to the thickness of about a quarter of an inch. It was better to make this floating of a good thickness, as in course of time the painting would get soiled, but the surface could be easily scraped off and the ground re-distempered. The next thing was to prepare the colours by mixing with a certain proportion of town glue, —and it must be glue, not the sizey material which was always more or less in a state of decomposition. A flat wash-tint was then put on, and then followed the process of stencilling or painting the design. Stencilling was, however, only used in the case of inferior work. The better class of artists prepared their designs on tissue or other paper, pricked the main lines in it with pin-holes, and then, by placing the sheets of paper against the wall, the lines were transferred by pouncing over the pin-holes with a bag containing a fine powder. The painting then proceeded. The final process was the "fixing" of the colours, which was done by throwing on to the surface, with a brush of peculiar form, a fine spray of dissolved glue. He should be glad to see the banishment of wall-papers from this country, and the use, in their stead, of the process of wall decoration which he had described. It was one which was eminently suited

alike to the homes of the poorest and to the homes of middle-class people, and was cheap and easy to carry out. Work executed in the manner he had described was easily cleaned with crumb of bread. One caution to be observed, in following the process, was not to use too much glue, for if too much were used the work would be liable to scale off.

HUGH STANNUS, *Associate*, said that, to his surprize, no one had ventured to challenge Mr. Madox Brown's dictum that the painter and not the architect of a building, which had to be decorated, should choose the subject. He suggested that the complete cycle of the storiation should be arranged in consultation with the architect, in order that the whole scheme of the architecture and the colour treatment and decoration should work-in together. This would insure a better result than by ignoring the architect It is always possible for the artist to choose the particular episode, in any given subject, which the most fires his imagination, and which he thinks the most fitted for artistic treatment; subservient always to such curb as the fact of forming a part of a decorative unity imposes. He thought that they were very much indebted to Mr. Crace for the clear and systematic manner in which he had treated his subject, and he was glad to see that Mr. Crace's observations went to endorse what had been said in a Paper, read in that room not very long ago by Mr. Seddon, who laid down the principle that decoration should be functional, or architectonic. Although Mr. Crace's cited examples were nearly all Italian, his remarks were equally applicable to work in all styles. One question suggested by the Papers and discussion was: Would it not be possible for us in England to more largely adopt what the French called *collaboration* in regard to the decoration of our buildings? Would it not more frequently be practicable, and to the advantage of the work, for the architect and the gentleman whom he proposed to call in to decorate his building to have some sort of preliminary agreement as to what was best to be done? Such a practice, recognizing the existence and necessity of each branch of art, while preserving the proper predominance of the architect, would carry out the principle of consultation, which he advocated in deprecation of Mr. Madox Brown's remarks, into still further detail.

THE PRESIDENT said that the subject most interesting to him was the possibility of the adoption of the higher kind of art which Mr. Madox Brown had been introducing at Manchester, and which was so much needed for the decoration of public buildings generally. Curiously enough, before coming to the Conference meeting, he (the President) had been asked to attend a meeting of the Society of Antiquaries on that evening to hear a Paper read upon some recent discovery of wall-paintings in a Lincolnshire church. He was also informed at the same time that a member of the Society of Antiquaries was now engaged in cataloguing the examples of old wall-paintings which had been discovered in England from time to time —an enormous number. A curious fact about these old wall-paintings, most of which had lasted from the thirteenth or fourteenth century, was that they were in none of the processes which had been discussed, but were in distemper. Mr. Armitage informed him that, thirty years ago, he executed some paintings in a Roman Catholic church in Islington, in fresco, but it had lately become necessary that something should be done to them, and he had been re-treating them by the Gambier Parry process. In a church which he (the President) built some years ago, in Westminster, Mr. Watts had painted a fresco, which, the last time he (the President) saw it, was covered with a white film. The lamentable injury which the frescoes

in the House of Lords had suffered was well known. Whether these failures were due to uncongenial climate he did not pretend to decide. Mr Gambier Parry's process appeared to have stood so well after a test of many years that he should be glad to see painters adopt it. Sir Frederick Leighton had informed him that the fresco, representing "The Wise and Foolish Virgins," which he painted some fifteen or sixteen years ago in the church built by Mr White at Lyndhurst, in the New Forest, was done in two instalments, the first being painted a year before the second was done. The painter, when he returned to his work after an interval of a year, expected to find that its freshness would be gone, and that he would have to do the first portion of the work over again. That

however, was not the case; for the painting had so well preserved its freshness, that all the artist had to do was to complete the picture. If that was a typical instance of how the decoration of buildings in fresco could be proceeded with at long intervals, it would be, perhaps, more easy to get buildings decorated by painters of eminence than was sometimes thought possible, for it would enable them to undertake such work without having to leave their homes for long periods. He agreed generally with the remarks made by Mr Crace, particularly with regard to mosaic decorations, which did not look well unless the building had been erected for them. He thought that Mr. Crace had not taken note of the injurious effects which interior

decoration had very frequently had upon Italian Pointed buildings.

*** This, the Sixth General Conference of British Architects, held in London, was brought to a close by the adoption nem. con. of the two following Resolutions, namely:-

That the thanks of this final meeting be given to the Conference (General) Committee and the various sub-committees engaged in carrying out the programme of the several meetings and visits held during the week of the Conference. [Proposed by J. Macvicar Anderson, Hon. Secretary, and seconded by William H. White, Secretary.]

Also that, on the part of the Provincial and Scotch architects who had attended the Conference, a hearty vote of thanks be offered to the Council of the Royal Institute of British Architects, in recognition of the admirable arrangements made for the reception and

entertainment of visitors and non-metropolitan Members of the Institute. [Proposed by Mr. Robert Morham, City Architect, Edinburgh, and seconded by Thomas Mitchell, Fellow, Manchester and Oldham.]

Royal Institute of British Architects.

INCORPORATED IN THE SEVENTH YEAR OF WILLIAM IV.

THE TRANSACTIONS.

SESSION 1881-82.

USUI CIVIUM, DECORI URBIUM.

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Table of Contents.

ILLUSTRATIONS.

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Royal Institute of British Architects.

INCORPORATED IN THE SEVENTH YEAR OF WILLIAM IV.

SESSION 1881-82.

1. THE OPENING ADDRESS. By George E. Street, R.A., F.S.A., *President*.

[Read on Monday, 7th November, 1881.]

GENTLEMEN AND COLLEAGUES,—It is a time-honoured custom that the Opening Meeting of the Session shall each year be devoted to a review of our position, the work we have done during the past year, the losses we have sustained, and finally the openings which appear to offer themselves for the promotion of that which, above all, concerns almost all of us: the advancement of the art to which we have devoted ourselves. We all know how much it pleases some of our critics to assert that the objects of this Corporation are selfish first of all, and devoted to the improvement of the art and the science of building only in a very secondary degree. I need hardly waste words upon a refutation of such statements. I am content to point to the volumes of our Transactions for the most complete answer to them, as well as to the experience of those who have served on our Council from time to time. The real object of the Institute of British Architects is very different; we exist not only because of, but for, our art. It is not because we are architects that we band ourselves together in selfish opposition to the interests of the world, but rather that the interests of the outside world and of our profession may be harmonized and proved to be identical; and equally that our well-loved art may be more studied, more admired, better understood and more widely practised, not only by ourselves but by the public outside our ranks, than it is. The real interests of the public and of ourselves are identical. The obligation to carry on the business side of our work upon the highest rules of honour or integrity, as between man and man, is placed in the very front of the conditions of membership of this Institute. We admit of no compromise or conditions; and the condition of membership here is undoubtedly that of working thoroughly in the spirit and traditions of gentlemen. In addition to this, the practical work which we have to do is, by meetings, by reading of Papers and by discussions, to keep up and increase as far as we can the general interest in, and knowledge of, our art, without which neither accomplished architects nor an intelligent public will continue to exist. Naturally our work of this sort divides itself into that which relates to the scientific, and that which is concerned with the artistic, side of our art. I think there has of late years been rather a tendency to devote more time to the former than to the latter; for the art of building, the art of draining and the like are exact, and do not admit of perpetual discussion. The development of attention to the study of novelty in construction is not always for the advantage of good building. Half the inventors, whose circulars cover our tables every morning, claim as the chief merit of their inventions that they are cheap, and I would that occasionally they convinced us that they are equally lasting. I maintain that British architects are honourably distinguished for the way in which, as a rule, they deal with all those questions of new forms of construction,

of water-supply, of drainage, of the general conditions on which comfort and convenience in our houses depend. English comfort is a proverbial expression almost all over the world, and our architects are fairly entitled to a large share of the credit of its creation.

I wish that it were quite possible to make the same assertion with regard to our artistic successes. It strikes me more strongly, the more I think of it, that we cannot escape some responsibility for the bad work which is done by builders without our aid. How is it, it may fairly be asked, that, with an ever-increasing body of architects, educated and trained more and more carefully, the vernacular architecture of the country becomes worse and worse every day? The vernacular architecture of a country is that which the carpenter, the bricklayer, the mason, the smith or the plasterer, does if left wholly to himself. We all know that the time was when little even of this work was wholly contemptible; take even the last century, and in such work one sees a simplicity and restraint in design, an absence of vulgar display, which make one feel a charm in work most of which certainly never passed through an architect's office. Go from the house built in the suburb of an English country-town in 1750, to one of the houses which rise in countless numbers on all hands now, and your verdict, as architects and as artists, must always, I fear, be given in favour of the former. Compare the two, and you will find that the taste of the eighteenth-century builder was for simple and good before ornamental work, so that he seldom came to the latter at all; whilst the taste of the nineteenth-century builder is to do everything for display, sacrificing the money which might have made his work at least substantial to an investment in so-called ornaments to the show fronts only of his house, which are costly to put up, costly to keep in repair, and hideous in their ghastly unfitness for their place. They have some "compo" keystones, ornamental railings and balconies, a few lumps of terra-cotta, elegant cornices and window-dressings, and highly suggestive chimneypots; and for the sake of these the house has walls and floors so thin that every sound can be heard throughout, and so weak that in a heavy gale you rock in your bed. For all this of course we are only indirectly responsible. Though it must be admitted that too many, if not all, of us, think too much of the fronts of our buildings, and so have practically brought up a whole generation of builders and workmen to believe firmly that all buildings ought to have a show front; we so often sacrifice solidity to the pleasure of creating what we call ornament, that we have led them naturally to assume that ornament is an object by itself to be clapped on to a building at all hazards, and even at the sacrifice of solidity. I should much like to see your attention more and more turned to this large and serious question; it deserves discussion and action, for depend upon it some screws must be very loose indeed in our system, if all our work is so wholly outside the world, as not to influence the vernacular architecture of the people for good. My only suggestion at present is that our duty is to show by example that simple building may be quite as good as extravagant building, that the essence of all good architecture is that it should be solid and lasting before it tries to be ornamental, that ornament is a feature which grows out of utility, and cannot be applied to a building like a loose-fitting garment, to cover defects or distract attention from parts which are not supposed to be seen. I wish heartily that, before all questions of style, this vital one of solidity were always present to us when we are making our plans. The builders who have been trained by architects who never build what is not solidly and well-constructed are much more likely to build for themselves in the

same spirit and way, than they ever are if they have been otherwise taught. And after all it is the work done by builders, without the intervention of an architect, that we principally see, wherever we move in this ever-increasing city, and in others similarly conditioned.

There is another question to which the one just mentioned naturally leads, and this has to do with the extent to which we may be able to affect, in the interests of our art, the future architectural arrangement of the streets and buildings throughout our great cities. To state the case in this way is perhaps in fact to answer it, as far as relates to direct interference with, or influence over, what is done by municipal authorities; though as our Institute boasts properly that it is a British, and not only a London, Institution, our object ought always to be to keep this fact well before us, and to act even out of London whenever the importance of the case demands it. In 1876 the late Mr. Wyatt, in the course of a discussion on Mr. Eastlake's interesting Paper on the Work and History of the Institute, told us that the author had omitted to mention one proof of the growing influence of the Institute. This he saw in the request, which had just then been made to us, to exercise control over the designs and elevations of buildings in Northumberland Avenue; a request which afterwards became a law to the extent of making it necessary that all these designs should be "submitted" to the Council of the Royal Institute of British Architects. Well I know not, gentlemen, what the general feeling on this subject is now. Some I know agreed with the view which I held at the time, that the position we were taking was a dangerous one, and one that could do no sort of good to our art. The taste of the individual members of a council may be excellent; but there is an unwillingness on the part of a body of men to criticize too severely, or to agree in suggestions as to the alteration of, the work of a brother architect. Opinions differ around our own table as to what is best, sometimes even as to what is good, to such an extent as to end in approval being given in a general way to works in which probably every one of the Council in his own heart can see little good. Nor is this all. The elevations alone, which are not complete without plans, are submitted; modifications of a very simple kind alone can be, and are, advised, the advice is neglected, and the building is after all erected with little, if any, attention to the opinion of the Council of the Institute. In the end, if Northumberland Avenue ever becomes an avenue of buildings, the Institute will have to ask itself whether the control it has exercized has been sufficiently strong, whether the result has been so good, in comparison to that of the streets in which we have not been able to interfere, as to justify Mr. Wyatt's satisfaction. For myself I have no hesitation in saying that it would be better, if we are to have no more power than at present, that we should have less.

I do not think it right to close the few words I have to say on the Northumberland Avenue question without endorsing what fell from my predecessor in this chair on the subject of architects who are members of the Metropolitan Board. He was speaking of the business relations which constantly bring members of our body, as well as the Institute itself, into correspondence with the Metropolitan Board of Works, and he concluded with the expression of an opinion, in which I concur so completely that I think it only right to repeat it. Mr. Whichcord's words related to the composition of the Board. "Architects," he said, "may be elected members of that Board just as barristers, solicitors and doctors may be so elected. It would be ridiculous to say that professional men shall not sit at that Board because they may have had a pecuniary interest in some of its public building transactions. But I shall run no risk

of censure when I say that a Fellow or an Associate of this Institute, if he be elected a member of the Metropolitan Board of Works, ought not, from that moment, to have any professional connection whatever with the purchase of land offered for sale or lease by the Board; nor should he be professionally engaged in the superintendence of buildings to be erected on land which is the property of ratepayers whose agent and representative he is." Such a statement is so obviously right, and beyond question, that I am sorry it should be necessary to repeat it.

Upon the broad question of giving general advice through our Council, I feel sure that the Government, or the governing bodies of our great cities, might well, and with advantage to themselves, consult us from time to time on the preliminaries of great building operations; and I have no sort of doubt that we should always be willing to give the best help in our power. Whether the points to be settled are the best routes for new streets, the best sites for great public buildings, or the best openings for architectural improvements, it would be advantageous to every one if the subject were laid before a Committee of experts—such as the Members of Council of this Institute are—for advice and opinion. Take such cases, for instance, as the choice of a site for the new Courts of Justice, or as the choice among various schemes for the placing of the new Government Offices which are even now required; or as to the conditions on which railways are to be brought into London or across our river, and it is obvious that our opinion might well be asked, and almost certainly be acted on, with advantage to the country and without prejudice to any one. In the last case, for instance, can it be supposed that, if we had been consulted, the House of Commons would have allowed the London, Chatham and Dover Railway Company to erect their bridge across Ludgate Hill, and to erect an almost equally ill-placed bridge across the Thames, within a few yards only of another built on wholly different lines? Nor would the South Eastern Railway Company have been permitted to build the two gigantic and odious sheds on the river-side, which have been the ruin of so much of the beauty of the matchless prospect. Such subjects lead me to say how useful a function this Institute might perform, if it could keep a more active surveillance on the mode in which the works of deceased artists are dealt with. I am not among the passionate admirers of such a work as the General Post Office, but at any rate it was a consistent design, carried out in an honest and uniform spirit, and complete in outline and character. New wants have arisen since it was built, Rowland Hill has come and gone, and more and more accommodation is required. But it is almost beyond credence, that some of that required space should have been obtained by a series of erections on the roof of the original building, hideous in themselves, and wholly careless of the effect produced, or even of having in themselves any architectural character at all higher than that of a thirdrate house or workshop. Yet so it is. And perhaps it was because, for years, the porticos and colonnades of another great public building—the British Museum—were entirely filled with glass cases and partitions, without any outcry from the public at such a defacing of a consistent and costly design, that the Government which represented the country was so heedless of the monstrosity of which it was guilty, when it made the additions to the Post Office. Nor is it out of place here to ask when the front of the Colonial Office in Whitehall is to be finished? Its architect evidently prepared for the erection of two towers or pavilions at the angles of the front. His proposals were not acted on, and there, to the present hour, stands the building with its two most important angles evidently unfinished. Every day a large proportion of the

members of both Houses of Parliament, and most of the Ministry, pass under the walls of the unfinished building without, I suppose, a thought of the injustice done to the memory and reputation of one of the greatest architects of his time. Surely on such a question as this the Institute of Architects, if no one outside will move, ought to take some action.

Then again I hope we are all agreed that there is no work in which we can as a body do better service to our art, or more certainly show our real sense of its value, than by sturdily opposing all schemes for the destruction of existing works of architectural art, or of works possessing historical or archæological interest. We have, as you know, a committee for the conservation of ancient monuments; it is a strongly constituted committee, and its existence cannot be too widely known. There is always work for it to do. Take for example the case of the City churches. It is no exaggeration to say for myself, what I doubt not very many of you feel also, that when I return from some foreign travel, and cross the railway bridge into Cannon Street, I feel a pride in the architectural beauty of the City of London, which is never lessened by contrast with what I have been seeing elsewhere. And to what, may I ask, is the beauty of this view owing? There is a magnificent river and a sublime bridge, but beyond and above these a cluster of towers and steeples, of so much variety of design, so skilfully treated, so picturesque from every point of view, as to afford unending delight. In the year 1800 there were 107 churches in the City; in the year 1877 only ninety-five remained, and of these there were no less than thirty-one scheduled as "at present" to be pulled down. Only the other day another of Wren's reputed churches, St. Matthew, Friday Street, was said to be condemned, and though the particular case is not a strong one, it seems to me high time that this Institute should strain every nerve in order to save any more such regrettable destruction of the buildings to which London owes much of its pre-eminent beauty. If architects stand by quietly, it may be assumed that there are no artistic objections to such works. We may still permit men to go on in the cheap and easy fashion of making our ancestors' piety and liberality pay for building and endowing churches which we, with all our increased wealth, choose to think we cannot afford to erect; and by the time that all the empty churches (consequent largely on a non-resident clergy) have been removed, and their sites sold for counting-houses, shops, banks and what not, men will awake to the discovery that the architectural beauty of the City is a thing of the past, and that the loss is irremediable. At the West End I hope the same words of warning are not required. We have been appealed to in reference to a rumour that St. Margaret's, Westminster, was to be taken away. This is a constantly recurring rumour. The penny-a-liners probably think that every one wishes it removed. They forget that it has just been refitted at great cost, that it is a building full of architectural and historical interest; and they are not aware that the builders of our great churches and cathedrals, being artists, had never any objections to the erection of small buildings near to, or in contact with, larger ones, to which they gave infinitely more value and scale than the latter otherwise possessed. I am glad to be able to assure you, however, in this case, on the best authority, that there is no foundation whatever for the rumour.

It is remarkable to notice how much is lost on all sides for want of some active hands to save threatened works of art. We, who have passed the age of fifty, look round on the Paris, the London, the Florence, the Cairo, the Venice of our youth, and find that on all sides work has been destroyed, mainly it would seem for the sake of change, for the loss of which no new

building will ever atone. In London there is the well-known case of the colonnade of Burlington House taken away upon the understanding that it should be rebuilt, but lying in a mouldy heap somewhere on the other side of the river. In some similar limbo, I suppose, are the stones of Temple Bar, for the re-erection of which, in some spot not far from its old place, such for instance as an entrance to Temple Gardens, surely funds might without difficulty have been found. Further to the west is an even more interesting work—the Water Gate at Buckingham Street, Adelphi—treated in an even more ingeniously-spiteful way. For here the lovers of the beautiful have created a garden with lawns and shrubs and winding walks, which one would suppose might have been allowed to undulate as well as to wind. At any rate even now the level of the garden might be lowered for some distance, on either side and in front of the gateway, and Inigo Jones's work might again be seen in its integrity, instead of being earthed-up to nearly half its height, and of having its archway used as a receptacle for rubbish, and the decay of its old stonework hastened as much as possible by piles of damp earth and plants carefully placed against it by the landscape gardener. And, to conclude, there is the case of a church in Edinburgh, for taking down and re-building which, on a new site, stone for stone, a railway company were bound to, and did, provide the funds. Here again the stones remain in a heap, and the Corporation, unless they are much traduced, have kept the money for their own municipal purposes.

I might easily multiply examples of the same kind. They all seem to point in the same direction: to the necessity in such a country as ours for the creation of a Government Department of the Fine Arts, whose office should be not only to give order to our magnificent but often confused and inaccessible collections, but to take care that our national buildings and our historical monuments are classified and preserved as far as possible from further damage either at the hands of time and weather, or at the equally destructive hands of those who (as in the case of the Post Office) have no hesitation in wholly destroying the architectural character of a great public building. I believe that the appointment of such a ministry might be followed very soon among other things by an addition to our museums, which has often been urged strongly—but hitherto unsuccessfully—of a museum of casts. Every one admits the advantage to students of art of such a museum. Berlin has shown us the way, and the expense could not be so great as to be a difficulty in the way of so rich a country as this is. Moreover it seems to be a necessary complement to the other collections which have been accumulated within the present century, as affording the very best means of educating the eyes of a people who are undoubtedly holding their own against foreigners in all artistic matters far better than they did before such museums were first of all formed. The collections at South Kensington, to which all who are interested in our art must always most gladly confess their indebtedness, contain no doubt a good many most valuable casts, but they represent only comparatively modern art, and even then are in no degree whatever complete, and they are not, as they should be, exhibited by themselves, or classified in such a way as to be thoroughly useful to students. I hope that we shall keep this subject well before us, and that no opportunity will be lost of pressing upon Government the sense that this Institute must feel of the importance of such an addition to our national collections. It is a feeling which is sharpened in us by the knowledge of the fact that such a museum would, to a very large extent, illustrate the close connection which ought to exist between the work of the sculptor and the architect. The best works of the

greatest sculptors have nearly always been their decorations of architecture; and the evidence of this necessary connection before the eyes of the people is the best way of familiarizing them with the fact, and of leading them to feel the want in those of our own buildings, where, even when the architect has advertized his desire to see sculpture introduced, the spaces he has left for it are still, as a rule, conspicuous by their emptiness. The Government which, with a large and wise liberality, would deal with such questions as these, would secure for itself perhaps less temporary popularity, but would have the satisfaction of knowing that it more permanently benefited the highest interests of the community than it could by exclusive attention to purely political questions.

At the recent Conference, the question of Competitions led to much discussion, and the resolutions arrived-at have been discussed by the Council, who will ere long lay before you the result of their deliberations. The position which I hope will be taken by you will be to arrange that, in the event of a competition being indulged-in, due securities shall be given for really accomplished assistance, advice or judgment on the competing plans, not only in regard to technical questions as to compliance with conditions, but at least as much on true artistic questions, which are even more to be considered and more vital. But it is, I hope no part of our business or duty to do so much, in the way of facilitating competitions, as to lead the world to suppose that we are in any sense whatever admirers or encouragers of a system, the defects of which, under the best arrangements, are so many and so patent that the best men keep themselves wholly or almost entirely out of reach of them.

Our numbers still continue to increase. Last year at this time the total number of Fellows and Associates was 716. The additions during the year have been 28 Fellows, 143 Associates, 9 Honorary Associates, and 9 Honorary & Corresponding Members; and deducting the losses which we have sustained by death or otherwise, our numbers now stand at 370 Fellows and 491 Associates—a nett gain of 19 Fellows and 126 Associates. It is to be hoped that this large accession of new members does not mean that we are reaching a lower level of qualifications, but rather that the Institute is becoming more recognized as the centre of our work. A large increase of members involves also an increase of our means, and additions to our Library, which is rapidly increasing and is now of great value. Another addition to our means of doing good work is Mr. Godwin's generous foundation for the promotion of the study abroad of modern structures, building improvements and adaptations in parts of Europe other than Great Britain and Ireland, and in America. This has the special peculiarity of being open to all British subjects of any age, and it will, there can be no doubt, be of high value in its results to the profession.

The death of William Burges took from us unexpectedly, and in his full vigour, one whose belief in his art, whose devotion to its study, whose enthusiasm for his work, have rarely been excelled. A student from first to last, an artist whose hand was always seen in every detail of his work, his example is one to be held up for our admiration and our emulation. He knew that unless an architect's work be good and thorough it has no enduring life. He knew that this lesson required to be taught us more than any other, and he made it the business of his life to teach it; and I honour him the more that he gave to others what he had with infinite pains learnt. It was one of his greatest pleasures always to discuss, in public or in private, old modes of procedure, of manufacture, of

design. There was nothing selfish in his acquisition of architectural or archæological information. He was as ready to communicate as he was to acquire, and many of his published papers are replete with learning and information. The study of early French Pointed architecture had evidently produced a very strong and lasting effect upon him as an artist. He revelled in the somewhat rude and ponderous version of it which he affected, and in the sculpture and the decoration with which he rejoiced to overlay his work he allowed his quaint and exuberant fancy to have full play. There was so much originality in what Burges did, that his work was certain to be criticized. It was warmly admired and as warmly opposed, and he would have been the last man to wish it otherwise. In one thing at least all are agreed: his death was a real loss to our art. The Royal Academy had at last recognized his undoubted claims; and unfortunately it still remained for the Institute of Architects to follow with a testimony in the shape of the Royal Gold Medal, the bestowal of which, I am sure, could not have been much longer postponed. In Frederic Ouvry we have lost an adviser, who was not only always ready to give us his valuable counsel whenever we asked for it, but we had the satisfaction of seeing combined in him the able solicitor and the accomplished antiquary. For the greater part of his life he had been an active member of the Society of Antiquaries, of which he was for very many years treasurer, then vice-president, and finally president, after the death of Lord Stanhope. Among foreign architects, whose deaths we have to deplore, are some of great mark. Hector Lefuel, a Member of the Institute of France, was well known to many of us by his works. The names of Davioud and of Mariette Pasha must not be forgotten, for both did great work in different directions, and will long be remembered, the former especially by what certainly was a bold flight of genius—the Trocadero building; and the latter by his researches among the monuments of Egypt.

The architectural publications of the year do not appear to be numerous, and I cannot say how much I regret this. Nothing in my opinion tends more to raise our art than some attention among us to the literary illustrations of architectural history and style, in which so many architects have, in past times, distinguished themselves. We have examples, in the case of some of our oldest members, which may well be commended to the notice of their juniors; for nothing, let me assure them, so certainly gives young men their first footing on the ladder which leads to fame and success. Our old Librarian, Mr. Dollman, has shown us how valuable a work it is possible to produce in his monograph of St. Mary-Overie's Church, as to which I have already had the pleasure of expressing my opinion here. The Society of Dilettanti has published another part of the antiquities of Ionia, in which, seeing that Mr. Newton, Mr. Watkiss Lloyd, Mr. Pullan and Mr. Fergusson, have combined their forces, we need not doubt the result. The magnificent government work, the *Monumentos Arquitectònicos de España* is still going on, and we are looking forward to the early publication of Herr Richter's promised edition of Leonardo's Treatise on Painting—a work which will have almost as much attraction for architects as for painters, for among the hitherto-unpublished drawings which will be contained in it, many, I understand, are architectural designs.

No important public works have been completed during the year. At Vienna, at Brussels and in Paris, great works are being carried out, all undertaken in a spirit of lavish expenditure, somewhat surprizing to us in this country. The Cathedral of Cologne has been completed—the most gigantic work of modern times—in presence of which all unkind criticism ought to be

hushed in admiration of the grandeur of the idea. The so-called restoration of St. Mark's, Venice, has I hope, for a time, been arrested—whether permanently or not it is impossible to say. Only too frequently works are done for which the necessity, if it exist, cannot but be regretted. Such a case is that of Coutances Cathedral, where the north-west steeple has been made to look as it might have done, when first built, by the obliteration of every mark of age. I most sincerely trust that this may not be the forerunner of an entire scraping of the whole of that magnificent church! The question of the restoration of ancient buildings is one which is constantly coming up for consideration, and I am constrained to say that, unless the very greatest care and judgment, and the utmost reverence for every relic, actuate the restorer, restoration is not only a serious risk but an unmitigated evil. There is the risk of doing too much and of obliterating every sign of antiquity. Such works, in our own country, as the re-decoration of the Chapter House at Salisbury; or in Germany, such works as the decoration of the Castle at Meissen, and the far more interesting Castle on the Wartburg near Eisenach; or in France, such as the re-decoration of the interior of the Sainte-Chapelle, fill me, I confess, with distress. No one wishes more than I do to see our painters at work upon our walls; but I do not wish to see their works obliterating, as they do at the Wartburg, every mark of antiquity inside the building. Our new walls and buildings are numerous enough for all that they can do; and in the repair of old work—it is the repair strictly speaking that is the one thing needful, beyond which it is undesirable to go, and even this ought never to be treated as proper work for any but the most skilled hands.

The proposed repetition of the Electrical Exhibition will be full of interest to those who have not made it their business to visit Paris during the Exhibition there; hardly second to this, in its interest for architects, is the Smoke Prevention Exhibition, which is to take place, this month and next, at South Kensington. There is small encouragement in London to use the best materials for building, if they are to be defiled as soon as built by the foul atmosphere which we create for ourselves; and our utmost endeavours ought to be given to the cause of clean lighting and clean warming, if we have any care whatever for the permanent effect of our buildings, both internally and externally. Among other subjects, which I hope the Council will see their way to bring before you, are suggestions for the consolidation of the Building Acts for the whole country in one uniform Act; the preparation of such a statement on the subject of the Law of Light and Easements as may help to form the basis of an Act of Parliament to do away with the present uncertainty and variety of opinion and practice; and the Council will no doubt feel it necessary to submit some amendment on the present mode of electing to the highest office in our body.

Next year, according to the established custom, it will be the turn of a Foreigner to receive Her Majesty's Gold Medal, and on these occasions it is sometimes of necessity given to one who has no connection with this Institute. I do not hesitate to say that if the best man in our profession be outside our own ranks, we shall better obey the Queen's intention, and gain more credit by recommending him, than if we insist upon regarding membership of our body as a preliminary condition for the award, which practically has hitherto been done.

The most serious matter before us, next year, is the first Obligatory Examination for admission to membership. It would be strange, indeed, if, in a land of freedom such as ours, there had been but one opinion as to the wisdom of the proposal, but it would be almost

equally strange if, in a land of order such as ours fortunately is also, the examinations were not carried out with due zeal and thoroughness by your executive. Some of us may think that old times were not so very bad, and that the want of some small preliminary technical culture and education did not prevent many of our British architects from being really great men. But these are not the sort of men who will be affected by our examination, the object of which is rather to raise the general standard of education, and so to keep out of the Institute those who are wholly incompetent, than any vain hope of suddenly creating an unlimited supply of admirable artists. We must not lift our expectations too high, or we shall certainly be disappointed. At the same time I feel very decidedly that it is our duty to take care that the examination be a *bonâ fide* one, involving careful preparation on the part of the candidates, and a real acquaintance with at least the groundwork of an artistic and a professional knowledge. It is obvious that there will be no difficulty in testing satisfactorily the ability of all who come to be examined in many of those branches of our work wherein every one who intends to act as an architect ought to be well grounded. The power of drawing, accurately and intelligibly, plans for buildings which will stand when built, is a *sine quâ non ;* and as to work of this sort we shall have no difficulty in framing sufficient tests. The far more real difficulty is in an examination into the capacity of candidates as artists; and here I feel that it will not be desirable to make the test very difficult, for I know well under what difficulties students often labour. As a visitor and teacher for some years in the Schools of the Royal Academy, where, probably owing to the examination at admission, the ability of the students is above the average, I have, with constant regret, to see a singular want of acquaintance with the first principles of architectural design, and with the rudiments of architectural detail, which mark the work of many students. But I hope all here will agree with me, that it would be a fatal mistake to make the artistic part of our Obligatory Examination so very easy and rudimentary, as to allow even the most ignorant of our candidates scraping through. The examination once instituted must be a real one, in the sense of meaning that the candidate has at least reached some fixed standard—even if a rather low one—of efficiency all round. My own opinion is that such a standard should, as far as possible, be so settled at first as to remain permanently the same. We are not likely, so far as I can judge, to have a better-prepared class five years hence than we have now. All the necessary means of education exist now, and have long existed. The system of pupilage, which enables men to learn exactly how those who have succeeded in making their mark are in the habit of working, is no doubt the strong point of our English system ; and this can be supplemented by work in London under the professors at King's College and University College, and both in London and the provinces under the Government teachers. Then there is the Architectural School of the Royal Academy, presided over by an active Fellow of our Institute, and where the students have the advantage—and from the crowded state of the school there can be no doubt they feel it—of the personal teaching and direction of most of the architect-members of the Academy in succession. Finally, there are the inducements held out, both here and at the Royal Academy, to the more able and earnest art-students, in the shape of prizes more or less attractive, and only to be gained by those who have achieved considerable artistic excellence. No one can fail to be struck with the high average of the work submitted in competition for the medals and prizes which we annually distribute; whilst at the Academy, though the

excellence of the competition has been for many years very remarkable, I am sanguine that the alterations just made in our laws—with among other things the provision of a travelling studentship of £200 attached to the Architectural Gold Medal—will produce an even better effect. The further new provision of a travelling studentship for travel in the United Kingdom is valuable, as showing that the existence of native art worthy of study is at last recognized by the Royal Academy, treading in the footsteps of our own Pugin Travelling Studentship, of which, as we know, the results have been eminently satisfactory. We shall all agree in allowing that such successes as the gaining of these artistic prizes in competition, either here or at the Royal Academy, will count as somewhat more than any artistic examination which can be conducted in a few hours; and in the same way, when a graduate of one of our universities presents himself for examination, it is evident that what he has already had to do for his degree will not require any repetition at our hands. The Institute having taken this examination in hand, we must all do our best to insure its success, and in one respect many of us can do more perhaps than we do. It is the master, doing bad or inferior work, who ruins the prospects of those whose education he has undertaken; the better the master's work, the better will be the prospect of those who have been trained to look up to him. I think I may dare to say that our English School of Architecture has, in some respects, made marked progress within the recollection of most of us. No school, I believe, has advanced more in draughtsmanship, whilst the study of ancient examples, at the fountain head, has become universal among all those who have any enthusiasm or ambition. The individuality of the artist, the special mark of English art, is stamped as strongly on our architecture as it is upon the sister art of painting, and I trust that we shall always steer clear of any attempt to follow foreign systems in this respect. I heard, only a short time ago, the lively expressions of regret of a great German authority, that their Governmental system of teaching deprived them of the enviable independence and originality which struck him so much in our English system of architectural training.

Let me now say a few words to those who at present do not see their way to joining our ranks. They are of two classes—the old and the young; of the former, it would be idle to ignore the fact that some very eminent names do not appear in the list of our members. Whatever the cause of their absence, I cannot say how much I regret it, and how heartily I wish it were possible to induce some, if not all, of them to give up their self-imposed isolation. I know it is asserted from time to time that the Institute of Architects concerns itself with nothing but questions of professional practice, professional etiquette, professional payments—that its whole concern is with the professional as opposed to the artistic part of our necessarily two-sided life. Well, gentlemen, I can only say that from first to last I have spent a good deal of time at your meetings and at your Council table, and my experience is not quite so dreary as such statements would, if they were justified by facts, make it. But men who think that less than the right amount of interest and time is here given to artistic questions should, by joining us, strengthen the hands of those—among whom they may count me—who more or less agree with them. No one is more loyal than I am in every respect to that Academy of the Fine Arts to which it is my fortune to belong. Were this Institute in the least degree hostile to it I certainly should not have the honour of occupying this chair. But I hold that it is impossible for an

instant to contend that all the artists in our profession are to rest quiescent outside, because some half-dozen seats in that body are reserved for a few fortunate architects. It was a wise and noble act, when the Royal Academy was founded, to make its constitution what it is, and to combine within its ranks representatives of all the arts. But our art requires much more, and I for one feel that we cannot too much interest ourselves in the work of this Institute, in order above all things that the position of our art as an art may more and more be recognized.

The younger Society is very differently situated. The Architectural Association is, in so many respects, working in a groove which runs parallel to our own, that I can never avoid feeling that some means might and ought to be devized for enabling that active body to join us. I feel that there is so much that is admirable in the self-constituted system of education carried out by its members, in the energy with which they pursue their work, and in the high excellence of very much of it, that I rather grudge their securing all the energy of the young for an Institution with which we have nought to do. Surely some plan might be devized by which our juniors might, under their own government, be training themselves until they gradually fall into their places among us, instead of as now finding themselves often obliged to belong to two Societies where one should suffice. And if it were possible—and it does not seem to me to be impossible—I should above all things like to see their connection with us established together with full liberty of self-government as to all those educational arrangements which they at present appear to manage admirably and to prize much. Few of us grow much better artists as we grow older. A man's best work is generally done between the age of twenty and forty, and we should all gain very much if our younger friends would occasionally read Papers, and join in discussions with their elders. What chance there may be of doing anything in this direction I know not; but nothing would give me more pleasure, during my time of office, than having to assist in any such fusion of the two bodies as might be found practicable.

There is again another class which might be more largely represented here than it is: the class of provincial architects. Some of our most distinguished members practice in the provinces, but the number of these who belong to us, compared to the total number of those who are really practising as architects in the country, is very small. I am well aware that the number of architects who could join us must be largely discounted: for among those whose names appear in Directories are many who are architects only in name. But making every abatement in this way, I cannot but regret that no scheme has yet been successfully launched for creating, in connection with this Institute, local associations whose members should be bound by exactly the same by-laws, and who, either in towns or districts, should have the right of electing annually their own representative to sit on our Council. It may be objected that if all my suggestions were feasible and were acted on, there would be no one left outside our ranks, and we should then inevitably attempt to make ourselves a close corporation. I do not fear this or I should not make such proposals. The British public, depend upon it, will take good care to retain its liberty of employing whatever architect in its wisdom it prefers; and the occasional incursion upon us of an amateur, or of a sculptor or painter, seems to me to be likely to do much more good than harm to us and to our art.

I have but a few more words to say, and they refer to that vernacular architecture of which I have already spoken. We have gone on far too long, enduring the existence of bad building on all sides, shutting our eyes to it, declaring it to be none of ours, and that

we can accept none of the responsibility for it. Believe me we are deluding ourselves. If the architects are now more numerous, more united and much more powerful than ever they were before, to what purpose is their unity and power if they cannot persuade those who build badly to build better? The fault I fear is with us. We hear architects of position plume themselves on being "practical" men; we hear them indulge in so-called practical discussions, whilst they earnestly deplore the over great attention which others would fain see bestowed on what they call merely artistic questions. So much is said about practice and practical matters, that by degrees they cease to realize that the business they are pursuing ought primarily to be regarded as an art pure and simple; and thus, looking first of all at the lower side of their art, they end by ignoring wholly the higher side. Do not mistake me. In our art the best artist is the most practical man. There is the highest art in the best disposition of a ground plan. There is equal art in the best construction applied to a scientifically-devized plan, and in the same way there is the highest art in so disposing the plan that the arrangement shall be convenient for the purpose and yet admit of well-balanced masses in the elevation, and well-arranged outlines and skylines. Beauty of detail is inferior in artistic importance to these qualities, but essential of course to a perfect work. I plead that, if we all in due order took this really practical view of the requirements of our art, all our buildings would begin by being well-planned, would next be soundly built, with elevations meant to bear inspection wherever seen. There would be no sham fronts, no false use of materials, or deceits as to construction; and if our nine hundred architect-members were all building in this way, depend upon it the day would not be far distant when good building would be so much the fashion, that the builder, unassisted by an architect, would not care to do such vile work as now he almost always aims at, and succeeds in doing. The conclusion to which I have come, after many years' experience, is that the honest, well-constructed building never excites contempt. We may regret that it has no style, but if it have the qualities just named it may be said to have the first elements of style in itself, and can dispense with anything adventitious. That fashions in art come and go, most of us have already seen evidences; but really good work is never out of fashion, whatever its style. One revolution we have seen accomplished under our very eyes. We have lived in the days of "compo," we are now living in an age of brick. We have seen the world outside us converted from the use of a bad and mean material to that of a good and an honest one; and I am sanguine enough to believe in the possibility of such a change, in other respects, as may make all building throughout England more tolerable, because more honest and less vulgar, than it now is. If I did not think this a matter which ought to be taken to heart by every one of us, I should not venture thus frankly to state my strong opinions. I hope that, in due time, our own consistent determination never to build anything which is not solidly and well-constructed, with the best art we can bestow, will not only make men honour us for our work but anxious, consciously or unconsciously, to build in the same way. Certain it is that, when we have accomplished this, we shall have just reached the point which, throughout the world, every good school of architecture seems to have reached long before its best period.

Sir FREDERIC LEIGHTON, P.R.A., *Hon. Associate.*—Gentlemen, I rise to ask you to express, in a vote of thanks, your appreciation of the remarkable Address to which you have

listened. The duty thus placed in my hands is doubly grateful to me. As an Honorary Associate of the Institute of Architects I hold it a great privilege to be permitted to ask for this vote, but as a member of the Royal Academy I rejoice at the opportunity given to me of doing homage, before his own throne, to that efficient and devoted officer who sits on the right of the President at the Councils of the Royal Academy. I do not propose to follow minutely his vigorous and lucid speech, but I will make one or two observations that have suggested themselves to me on a perusal of that Address, a copy of which I owe to the courtesy of your Secretary. Now, in the very fore-front of his remarks, Mr. Street has touched a chord to which every lover of the building art must, I think, warmly respond. He has lamented, as well he may, the vast amount of building work which rises to the right and left of us in weary acres, in all directions, wherein the architect indeed has neither hand nor part, but in which a reckless—I had almost said a criminal—structural flimsiness vies with a depraved vulgarity of taste. Under the first of these vices, no doubt the chief sufferer is the occupant, but the effect of the other is more far-reaching, for to the great masses of men the sum of their perception in matters of taste is, naturally, but the result of those fugitive impressions which follow one another, hardly noticed at the time, in the daily routine of their lives. I know nothing more certain to numb and deaden, in these masses, whatever latent spark there may be in them of perception of beauty, than this constant inhaling of what I may call the miasma of ugliness. I hope, with Mr. Street, that the frequent example of solid, tasteful and simple work may exercise a counteracting influence, and I may add what he surely thinks, though he did not say so; that in no way can you more certainly contribute, indirectly, to the chastening of taste, than by promoting the love for solid, simple and honest workmanship; and for this reason,—that this love for solid, sober and honest workmanship goes of a necessity with a dignified and sober tone of mind, to which meretricious tawdryness is wholly foreign and indeed absolutely repugnant. The spectacle of the unchecked production of ugliness in this country has inspired Mr. Street with the desire to see the establishment of a minister affected exclusively to the interests of art. There can be no doubt that, in the abstract, a great deal could be said in favour of such a scheme. There is no doubt that a constant and vigilant influence, checking with authority all that is bad in art and fostering with favour all that is good, would have a most beneficent effect; but I cannot help feeling, and I think you will feel with me, that very much is to be said on the other side, and that many and grave difficulties would beset any such scheme. In the meantime there is one controlling influence which is more potent than all, and which I think all of us should make it their best endeavour to educate, according to our strength and means—I mean the public taste. That alone is potent in the long run for what is good and for what is not good; and believe me, gentlemen, as long as the grotesque indifference to beauty, and the callous indifference to the hideous, which amaze while they humiliate us, in the people of this country, are what they are, and until they yield to a higher sense and more refined perceptions, the career of every true architect will, I fear, always be a lifelong struggle against the serried and stolid ranks of the Philistines. But amongst those schemes for which the aid, if not the initiative, of the Government is indispensable, I rejoice very much to see that the President gives prominence to one in which I have taken a great interest for some time. I refer to the creation of a

scientifically comprehensive museum of casts, such as we already see in Berlin, as the President has told us; and not only there, but, either in existence or in process of creation, in other Continental cities—Paris, Munich and even in little Switzerland, at Berne or Zurich, I forget which. Gentlemen, when we consider that, in all contemporary scientific research, or in nearly all, the key-note is Evolution, and when we further consider how faithfully the tone and temper of nations, and the growth and evolution of that tone and temper, are mirrored in the art of those nations, how much we learn of them through the arts which can be learned by no other means, it does strike me as very extraordinary that in this country, which is the stronghold of the doctrine of Evolution—nay its very cradle —so little should have been done to facilitate in this field the study of that great principle; and that, whilst biology and sociology, anthropology and philology, engross our strongest intellects, archæology should have a place so little adequate to its merits as a key to the study of mankind, quite irrespective of its intensely fascinating influence viewed on merely artistic grounds. That a perception of this want and this shortcoming is ripening, in minds in which it may eventually lead to practical action, I have some reason to hope, and I do not doubt that, at a day possibly not very remote, a young English archæologian may study at least the rudiments of his science without the necessity, as hitherto, of going to a foreign country for that purpose. Gentlemen, I will only refer to one more point. So loyal an academician as Mr. Street could not fail to allude to the development which the study of your great art has taken of late in the schools of the Royal Academy, but he has not alluded to those provisions by which the Royal Academy has sought to knit more closely the three arts which are its care, and to eliminate and set aside any barriers that may have hitherto existed between class and class, and that may have prevented the interchangeable study of those arts by all students alike. Those provisions are meant as inducements as well as privileges. We hope that they will be freely used and that they will conduce to the consolidation and mutual strengthening of three noble arts which are one kin.

Right Hon. A. J. B. BERESFORD-HOPE, M.P., *Past President.*—Gentlemen, I feel it a great privilege to be able to second the vote which my friend, and the friend of all of us, has proposed with so much eloquence—thanking you, sir, for that masculine, able, sensible, well-spoken and admirably-composed Address. I am using all these adjectives, not as a piling up of a fluffy, flimsy compliment, but as strictly critical definitions, as accurate as, on the spur of the moment, I can find to define that composition. Having known, myself, the heart-searchings, the trouble, the nervousness, of preparing such an Address and delivering it from that chair, I can feel how great must be your triumph, sir, at having so admirably fulfilled the duty that we annually impose upon our President—the tax we levy on him for the honour of sitting on that throne. We look on it as instruction for ourselves and instruction for the world, *urbi et orbi*—*urbs* being this room, and *orbis* the morning papers of to-morrow. I listened with very great interest to that portion of your Address, sir, in which you dealt with a suggested Ministry of Fine Arts; I listened with equal attention to the passing reference to it by the President of the Royal Academy. That is a point on which it is time for plain speaking. That idea of a Minister of Public Arts has been, as I believe, sir, you know, a matter on which I have thought myself, on which I have spoken out myself, and which, if I do not forget, was referred-to in one of those very inferior productions of a similar nature which I had the honour of

delivering here. Of course, as you said, we are none of us young men any more. I hope you do not mean by that to infer that we are very old men either; but we are in that staid, middle age which lifts us above the heads of our youthful contemporaries, and allows us to look at a wide landscape, and, looking at that, I couple what you say with Sir Frederic Leighton's very wise caution, and I say that a Ministry of Public Arts, if it will do enough and not do too much, will be an admirable addition to the official hierarchy. I define my caution in this way. I remember ten or fifteen years ago there was a fashion—there were one or two artistic journals and a few gentlemen who ably defended what they called the idea of regularity in public buildings by a permanent official. Now, against that I protested, and I do protest. A permanent official would be the stereotyping of an official taste or non-taste. He would be the suburban builder *in Excelsis.* A permanent Director of Arts is a thing to be utterly and absolutely scouted; and then, who is to be your removable Minister of Arts? The more all of us see the working of a public office, the more we see that the gentleman who sits on the front bench of the House of Commons or the House of Lords has his own mysterious master behind him: that awful potentate, shrouded in eternal shadow, the permanent under-secretary. Now, of course, if we have Ministers of Arts, we must have the permanent under-secretaries. I say let us try the Minister of Arts, but let us determine that the permanent under-secretary is not the permanent overseer. Again, the Minister of Arts must follow, of course, the mutations of the parties of the day. There is a Government in, say, with an enlightened man at the head, loving art, seeing that in the monuments of a nation much of its greatness rests. He will choose a good colleague for the Arts Department. Then there comes a series of bad harvests, there is a war with the Cannibal Islands, or something or other which makes a run on the taxes of the country. The next Government comes in, and a Minister of Arts is put in as a man who shall cut the arts of the country down to the quick. There is the risk. We must, as Sir Frederic Leighton says, fall back on public opinion, but in what we do, in making that half Minister, the First Commissioner of Works, a whole Minister, which, in fact, is what the proposal comes to, which I have always faced, we have to see these difficulties on the right hand and on the left. Then our Minister of Arts must not be so powerful as to override the great independent organizations which do so much, so cheaply, with such earnest self-sacrificing devotion on the part of their members—our own Institute, the Royal Academy, the British Museum, and other bodies, who might be ground down and made mere departmental bureaux under an officious and too official public superintendence. I trust the President will not think that I am throwing cold water on his suggestion, which is so valuable, but merely giving hints how best and most wisely to carry it out. For all safeguards for the discomfiture of the peripatetic builder and for the development of taste, I look on this crowded room, I look on that awful array—like the children of Israel crossing the Red Sea—of ballot-boxes this evening, which show how the Institute is growing in the public estimation of architects; and if it does grow, and if it does really display itself, not as a struggling competitor, but as the recognized voice, the controlling authority, of your great profession, it can never be sneered-at, as it has been sneered-at, from official benches, as a mere professional trade-union. Let us go on upon the good lines traced by the President,let us take to heart that admirable document, admirable in its business tone and literary merits, with which he has cheered, instructed and delighted us.

II. NOTES AND NOTICES OF DECEASED MEMBERS.

WILLIAM BURGES, A.R.A., *Fellow.*

BORN on the 2nd December, 1827, Burges entered, at the age of seventeen, the office of Edward Blore, after having passed five years at King's College (Lond.). At that period (1844) the works of Pugin and the erection of the Houses of Parliament had given a great impetus to the study of mediæval architecture, a movement in which Blore participated. The plea that "gothic" was essentially a national style, the fact that it could be studied without the necessity for foreign travel, as well as its evident beauty—then beginning to be appreciated—induced the younger members of the profession of architects to give it their almost undivided attention. With that enthusiasm which characterized Burges to his latest years, he seized every opportunity of making himself acquainted with mediæval works. "Some illuminations, still extant, which he executed at this early age" writes Mr. Pullan, his brother-in-law, "show how thoroughly he had imbibed something of their spirit, and this taste was confirmed during sketching tours through those counties which contain the best specimens of ecclesiastical architecture, namely, Lincolnshire, Norfolk and Sussex." In 1849 he entered the office of Mr. (afterwards Sir) Digby Wyatt. About this time he visited Normandy, and in 1850 went to Belgium and parts of Germany. France, his favourite field of study, was afterwards revisited, then Italy, and in both countries he made carefully-measured drawings of buildings and portions of buildings which interested him. In 1856 he gained, in conjunction with Mr. Henry Clutton (then of Charles Street, St. James's), the first award in the great international competition for Lille Cathedral, when the jury consisted of distinguished French and German archæologists, the second premiated design being the work of Mr. G. E. Street,* now the President of the Institute. The next year while in partnership with Mr. Clutton, the works of decoration at the Chapter House, Salisbury, were designed and carried out principally by him, and about the same time he was placed first in the competition for the Memorial Church at Constantinople. In this case he was so far intrusted with the execution of the building as to prepare working drawings and call for tenders from builders, but his relations with the Memorial Church Committee became unsatisfactory to both parties. Mr. Street was ultimately requested to make a design, and the church now standing in Pera was erected under that architect's direction. Burges, however, had the opportunity of visiting Constantinople, and the following extracts from a Lecture † he delivered on the subject afford a characteristic example of his method of observation and his descriptive power:—

"Stamboul of course possesses the greatest attractions of all the three cities; and the first things worthy of notice are the walls surrounding it on all three sides. There is nothing very remarkable in those on the side of the Golden Horn; but on the Bosphorus side a number of small columns have been built-in, a little above the foundations. I have often wondered whatever became of the vast number of columns contained in all the ancient cities; it would appear, however, from these walls, as well as from those at Galata, that they were often seized-upon as the most compact material whenever the walls of a city had to be erected in haste. The same thing occurs in the fortifications of the Acropolis at Athens, where we see built-in a good many

* Mr. Street died on the 18th December, 1881. † At the Architectural Exhibition, in January, 1858.

of the frustra of the columns of the old Hecatompedon. As to the monoliths of precious marble, they were considered too valuable to break up, and were, therefore, taken from the outside of temples and placed in the inside of churches or mosques. The walls towards the land side become triple, and are exceedingly picturesque. They also appear to have been more carefully constructed than those surrounding the other sides. The breach where the Mohammedans entered is still unclosed, and, according to the Greek tradition, will remain so until the victorious Christians shall enter in that identical spot in overwhelming numbers and drive the Moslem with great slaughter back to Asia, whence he came. As far as I remember, the walls are defended by simple battlements, without machicolations. The citadel of Stamboul is the castle of the seven towers, situated at the angle formed by the meeting of the Bosphorus and land walls. There were originally but four towers; Mohammed II added the other three. The building itself is very picturesque, but (at least in the Byzantine times) could not have been of any great strength, inasmuch as we hear of no stand being made there when the city was finally taken . . . . Now, from the architecture of these mosques there is a very useful lesson to be learned by the architect, and that is how admirably the details are simplified, and how great an effect of breadth is obtained by restraining the ornament to a very few places, such as the caps and cornices, and not covering the whole with reedy mouldings and fizzy crockets, and still more fizzy pinnacles. There is not much to be said about the bases, which are generally composed of a few mouldings, the uppermost being, as I said before, of bronze. The shafts are generally taken from old buildings, and consequently diminish, a point upon which I would venture to think the Classic architects were in the right. The cap is round at bottom to suit the column, and square at top to suit the arch. The surface is covered-over with the icicle work so peculiar to Eastern art. Here we see the ornament concentrated and very sparingly used; but it is the very finest and most careful of its kind. The abacus has a hollow moulding, with a square nosing, and the arch very often comes very nearly flush with the outer edge of it, so that none of the height of the arch is lost to the spectator; in large arches and columns, however, as with us, the arch corresponds with the face of the bell of the cap. The arches have no mouldings at all, but simply plain soffits, and occasionally the voussoirs are of alternate differently-coloured or painted stones. There is no label, properly speaking, but the whole of the spandrils overhang the arch from one to three inches according to the size of the building. In small edifices this soffit is left plain; but in great ones there is a moulding, which at a distance gives all the effect of a dripstone, without the disadvantage of depriving us of the view of any of the spandril space as our western labels do. The effect is to make the whole affair more massive, and to give the arch the idea of having more work to do. I should mention that there are three sorts of arches employed: a stilted drop arch (such as we find during the thirteenth century in Europe), a sort of four-centred arch, and a segmental arch; the latter is generally used for doorways. The spandrils of a large arcade, and their sustaining mould, are generally of marble, while the centre of the spandril is often occupied by an exquisitely carved projecting boss, or three circles of inlaid marble, with a little projecting knob in the middle of the whole. Now the carved boss is not an affair of a lot of leaves going out anywhere and in all directions; but a stilted half sphere, with a rigorously-kept surface, indented with a bold and deeply-carved conventional ornament. As to the cornice, it is formed of a rich icicle ornament with very little projection, upon this if the eaves project, they project very much, so as really to give some shade, and are boarded on the under side and decorated with paintings. If, on the contrary, the architect used a parapet, he pierced it with an ornament which, at first sight, looks very complex, but which can generally be resolved to the superposition of two or more geometrical figures. Each bay of an arcade is covered by a dome, protected from the weather by lead. In fact, where we should use quadrupartite groining the Orientals use a dome; and it is for this reason we see so many in every view of an Eastern city. The dome is finished by a kind of finial, often gilt; but as I was never able to get close to any of them, I am unable to say whether they are executed in stone or wood. As to the minarets, they are nothing but corkscrew staircases, standing alone; the winders go right through the walls, which are about six inches thick. Near the top is a gallery supported by corbelling, the ends of the corbel stones being kept down by the superincumbent weight of the upper part, which is merely a repetition of the lower portion, covered with a high-pointed wooden roof, leaded. Some minarets have as many as three galleries, and sometimes the corbelling-out is cut into icicle-work. Other minarets are made entirely of brick, plastered, and some even of wood, but as I was not able to go inside them, I cannot speak concerning their construction. There is no feature upon which the Mohammedan architect bestowed greater cost and attention than on his doors and shutters. One of the most elegant that I have seen is at present attached to a tumble-down house at Pera. It consists of two valves, each 1 foot 6 inches wide, made of fir, and covered with surface carving. The panels, with Arabic letters, form the principal feature, and work-in very prettily; but in the great mosques we find much more elaborate work. Here the doors are panel-

framed; but instead of the space between the rails and stiles being filled with a single panel, it is filled-up with a multitude of small rails and stiles inclosing minute panels of different coloured woods. In the richest doors these little rails and stiles form intricate patterns, and their panels are carved and occasionally made of ivory to break the monotony. Marquetry work of wood, ivory and silver is occasionally used, but very sparingly, and generally round the great panels. The doors are all strengthened behind by a strong skeleton framing. The furniture is bronze chiselled over with minute patterns and gilt; where the plate is pierced, the wood behind is painted red, as in the Suleimanyeh, or has a piece of red cloth behind it. The desks for reading the Koran, the chests, &c., are made of walnutwood, inlaid with mother-of-pearl and thin stripes of bone. The art is still practised by the Armenians, who, like the craftsmen of the Middle Ages, have a street all to themselves. At present, however, ornamental furniture is made by entirely covering the wood with mother-of-pearl and tortoise-shell. The pulpit and the more massive furniture, on the contrary, are composed of marble, and decorated with gilding; in fact as marble always was decorated in the Middle Ages. The windows we find filled by round pieces of glass set in the middle of a plaster frame-work, about four inches thick, this frame-work being set nearly flush with the external wall. Now within this, and flush with the internal wall, is another window, composed of small pieces of very thin glass, fastened, by means of lime and white of egg, to the back of a very intricate plaster frame-work. Nothing can be finer than the effect of colour produced by this description of stained glass; indeed, I am not quite sure but that our most famous windows of the Middle Ages would suffer by the comparison. The excellence is due firstly to the double glazing, which subdues and diversifies the light; and secondly to the internal frame-work, the mullions of which are very narrow but exceedingly projecting, so that a new effect is produced by every step taken by the spectator, for by reason of the projections of the mullions some pieces of glass are hidden and others revealed.* The only mosque retaining its stained glass windows is the Suleimanyeh; some say—but I do not know upon what authority—that they were made by Persian artists brought to Stamboul by Suleiman, after his Persian expedition. Unfortunately the mosque of Mohammed—the earliest of all the great mosques—has been so repaired that we cannot expect to find any of this most fragile work; but still it was excessively common in the upper parts of the windows of private houses, and is to be found in Syria and Egypt equally with Persia. If the art was introduced from Persia, it must have ended by becoming indigenous, as there are men who profess to make it at the present day. Upon the whole I rather suspect that it arose in the imitation of the pierced marble windows in St. Sophia, which are supposed at one time to have been filled-up with stained glass. Now, although marble is a very good material for simple geometrical forms, yet the labour of piercing an intricate curved pattern, as at the Suleimanyeh, would probably be an inducement to execute it in plaster, while the fragility of the new material would be protected by the double glazing. . . . .
I should observe that the lower windows of the mosques, which are very few indeed, are not glazed, but simply protected by an iron grille, and a shutter to shut at night; the sun cannot enter, as they generally open into the arcade. At Stamboul, as in Italy, all arcades have a thick tie-rod of iron at their springing. This may be justified in a constructional point of view, as tying the building together in countries subject to earthquakes; it also enables the builder to dispense with buttresses, which are very often fatal to all breadth of effect. I must confess to admiring the tie-rods in an artistic point of view, as they appear to connect the capitals one with another, and to define the springing of the arch. Some doors leading to external arcades, &c. are closed by bronze grilles, often of the most intricate patterns, but which pattern may still be explained on the same principle as the parapets or the stained glass. A good deal of bronze casting is done at the present day in the streets round the Suleimanyeh. . . . . From Stamboul our caique has transported us to Galata. Now what Oxford is to England, Nuremberg to Germany, or Assisi to Italy, Galata is to the East: an almost perfect city of the Middle Ages. Again, like all mediæval communities, the inhabitants had a more than doubtful story of their descent. As the Britons and Paduans were the descendants of the Trojans, so the inhabitants of Galata claimed descent from the companions of the renowned Brennus who destroyed Rome. They were Galatians: hence Galata. Some even went so far as to assert that they alone were the Galatians to whom the Apostle of the Gentiles wrote his Epistle. More sober authors, however, tell us the name simply signifies a place where milk is sold. Although a suburb in the time of Justinian, it owes its importance to the Genoese, who settled here during the Latin occupation. When the Greek dynasty was restored, they held it as a fief from the Emperors. Then they alternately assisted and bullied their benefactors, but having no fortifications were obliged to knock-under, until at last, happening to be on the right side against the Venetians, the latter burnt the town. The consequence was that the

* See the Discussion on *Persian Architecture and Construction*, in the TRANSACTIONS, 1880-81, page 174.

Genoese got permission to fortify it. Then they increased it with more fortifications; then they got the whole of the trade of the Black Sea into their hands, and when the Emperor refused them a further space to be fortified, the entire population turned out and worked at the walls, and inclosed the space without his permission—in fact they went-on very much as the East India Company did in India during the last century. I am afraid their conduct during the siege by the Turks will not bear examination. History accuses them of trying to make a separate treaty with Mohammed, and with neglecting to intercept his ships when they were hauled over dry land from the Bosphorus to the Golden Horn. However, Mohammed dismantled their fortifications, and of the three parts into which the walls divide Galata, one is now entirely inhabited by the Turks. The walls are even at the present day exceedingly perfect; they are about eight feet thick at bottom and five at top, where a broad space is got by means of arches supported on corbels. Many of these corbels are fragments of ancient columns, showing the haste of their erection. All parts of the walls contain inscriptions, with coats of arms, telling us the date of the building, so that their whole history might be thus collected. The walls are flanked at short distances by square and round towers; the most conspicuous of all was the large tower placed on the highest point and forming the citadel. Within the walls the most observable thing is the immense number of old stone houses. As to the churches, they have entirely disappeared; the only exceptions are (1) St. Peter's, which preserves its ancient gateway, probably of the time of the Latin occupation, judging from the mouldings which are almost all French. The central tower is also original. All the rest of the church, having suffered by fire, was repaired by the liberality of Louis XIV. of France. (2) Another church which has also a square tower, with a stunted spire covered with lead. Upon closer inspection it appeared to be now a mosque, the only remains of antiquity being a few carved strings, evidently of Byzantine workmanship; the church itself has been entirely rebuilt. The modern churches do not show at all. A passenger might pass them fifty times and never know that they were churches. The great Armenian church, built only a few years ago, is surrounded by an immensely high stone wall, secured by iron doors; in fact it has been the policy of the Turks to make the Christians hide their churches as much as possible, but it is to be hoped that day at least has gone-by. Nothing can be more effective, but at the same time more severe, than the houses built by the merchants of Galata; with the exception of the corbels, I do not think that a single yard of moulding could be found in the whole of them. The oldest house is the former Palazzo del Podesta, with round arches and a very few remains of Byzantine ornament inside. This building is evidently anterior to the Latin Conquest. The ordinary houses, which are all probably posterior to the destruction of the city by the Venetians, have their upper storeys supported on massive corbels. Now, as in by far the majority of cases there is no superincumbent weight to keep down the tails of the corbels, recourse has been had to iron bars, which are passed through them, having been fixed previously to a course of masonry a good distance down the walls; the expedient has been perfectly successful, for in very few cases did I find the corbels had given. Another peculiarity is, that generally the first storey does not project parallel with the ground floor, but at an angle with it, so as to get a window at the end to look down the street. The walls are sometimes built with layers of brick and stone, with very wide tuck-joints; thus the height of the brick will be one inch, that of the joint two inches, and that of the stone 3 to 5 or 8 inches. Occasionally a brick is placed between each stone, or there are two courses of brick to one of stone. The mortar is what is nowadays called 'corazan,' composed of lime and pounded brick, but with the addition of small pieces of linen, when used as an external cement for a whole wall. The tuck-joints formed of this cement received a pointing of fine marble lime, one-eighth of an inch thick; the bricks themselves, being of bad colour and quality, were painted with a mixture of lime and red earth. Sometimes the house was entirely plastered over, and covered with tuck-joints of the marble lime, imitating masonry. In this case the plaster was painted of a grayish colour and the joints left white. In another the plaster was left white, and the joints painted light red; or the marble lime was reddened by a little pounded brick being added; but in both these cases certain courses had bright red colour applied between the tuck-joints, which were made to assume an ornamental shape, so that these courses did duty for moulded strings. The examples just mentioned, as well as those in Italy, where ornaments are procured by putting two different coats of plaster one upon the other, and scraping away the other in certain parts, show what can be done even with plaster. I am afraid that ugly buildings are referable to the architect or the client, rather than to the material, however vile it may be. The roofs of these houses are always formed of tiles placed upon a few spars; the latter are supported upon the high square domical brick vault, which invariably covers the upper rooms. The vault does not go up to a point, but abuts against an oblong flat slab of stone which forms the key. The windows are simply two horizontal and two vertical travertine stones, with square jambs. Above is a discharging arch set about 1½ or 2 inches back from the face of the wall; a double row of tiles placed on the extrados brings

the superincumbent wall to the general surface, and, like the moulding we observed in a similar situation at Stamboul, does duty as a label. Every window is defended by a wrought-iron grille. The doorways are as plain as the windows, having segmental arches sunk back an inch from the general surface, in the same manner as the discharging arch of the windows. I should mention that these latter are generally four-centred, while those of the doorways are segmental. Only one sculptured figure remains: a small bas-relief in the High Street, representing St. George in the Byzantine costume. Now in Galata and Stamboul, but more especially in Tophana and the older parts of Pera, there are to be found an immense number of pierced iron door-rings and knockers of a most mediæval shape. I must confess that I am perfectly puzzled to account for them. Some of my friends have suggested that they were Genoese importations; for my own part I am rather inclined to believe that they are of native manufacture, considering how very mediæval some of the Eastern metal work is, even at the present day."

In 1859 he designed the Cathedral of Brisbane, in Queensland, and he rebuilt the east end of Waltham Abbey church.* At a later period he completed his work there by the erection of a sculptured reredos. In 1862 there was a competition among architects for a new cathedral to be built at Cork, and of sixty-three designs his was adjudged the best. This cathedral is the most important ecclesiastical building carried out by him, and it was not entirely completed at the period of his death. In 1865 the Marquis of Bute employed him to restore, or rather to rebuild, Cardiff Castle, and the liberality of the Marquis enabled him not only to pourtray unshackled his knowledge of thirteenth-century architecture, but also to illustrate his conception of the principles which are thought to have actuated the thirteenth-century architects. Some nine years afterwards,† Burges's work was described by one of his friendly critics thus:—

"It is too early to attempt a minute description of the parts of the castle now being executed—our task lies rather with the work already done; and an appreciation of the tower, as the work of one architect viewed by another, may perhaps be interesting. It should be remembered that, wherever evidences of the old work existed, Mr. Burges has been constrained to restore and add in the style of it; but everything which is absolute reconstruction is executed in the spirit of the best mediæval period, with an unmistakeable flavour or *cachet* which tells the beholder that no other than Mr. Burges is the author of it. The new tower, besides being the timepiece of the neighbourhood, is the distinguishing mark of Cardiff, viewed from a distance. No stranger passes-by without stopping to stare at, if not examine, it; and few of the Cardiff folk are even yet sufficiently accustomed to its outlines to regard it without a little wonderment mixed with their contempt. There is no ancient tower in Britain resembling it, few abroad; and, though in character essentially mediæval, it is practically modern. Perhaps the coloured statues of the planets, seven in all, and placed at the side of each clock-face, are the principal cause of astonishment to the casual pedestrian. Perhaps, too, the large size of these statues—much more than life-size—adds to what some will call the coarseness of the mouldings and decorative features of the exterior. But they do not destroy the scale of the building, and had they been made smaller—as would have been the case doubtless in the Middle Ages—the robustness of the architecture would have been impaired. Cardiff tower has the merit of explaining itself both in construction and decoration. The windows of one of the rooms are so narrow as to be mere slits, yet the room itself is flooded with light; the winter smoking-room, though pierced on three sides with windows and on the fourth with a door leading directly into the open air, is warm, home-like and, in a word, comfortable; the summer smoking-room is cool, lofty, well lighted, and it commands a magnificent view over plain, hill and water. No bachelor could covet a more enviable bed-room than the tower holds; and if there be many modern works of architecture in this country containing as much thoughtful art, within a space of equal dimensions, as may be found cut and depicted on the walls of Cardiff tower, England is more favoured than many of its children suppose. The decorations are not only legible, but to read them is a treat to educated people; the thoughts and occupations of the owner are translated in the things surrounding him. There is style in them—not the style of the multitude, but of a *grand seigneur*, who, from circumstances, has more sympathy with the past than with the present; who is poet

* Measured drawings of this church, as it appeared before the restoration, are preserved in the Institute Library.
† See a Paper (written by the present Secretary of the Institute) in *The Architect*, 14th March, 1874.

enough to choose poetical subjects for the decoration of his favourite rooms, and who, blest with vast hereditary possessions, chooses to make a little world of them and live in it. Opening the door leading from the ramparts to the winter smoking-room, the visitor perceives, in the ceiling of the little lobby, the grotesque head of some animal, with teeth savagely exposed, keeping guard, as it were, at the entrance. As he crosses the threshold and the inner door, he sees, in a panel upon the screen sheltering the latter from the fireplace, a device which, in symbolic character, puts the very pertinent question of who are you, and what do you want? In the same way the door-panels of the buffet are marked with emblems of the objects they are presumed to contain, and a cleverly inlaid head of an 'old tom' is portrayed in coloured woods to mark a receptacle for the beverage which Frenchmen suppose to be like mother's milk to the English nation. There are six windows in the room overlooking the street and the park, the upper portions of which, above the transoms, are filled with representations in stained glass of the six gods of our Saxon ancestors, equivalent to the days of the week, and called Mani, Thyr, Wodin, Thor, Freyja, and Satur. Raising his eyes to the vault, the visitor sees in the middle of it a representation of the sun. The twelve signs of the zodiac are depicted on the vaulting and the walls, and upon the latter are painted the occupations of the four seasons in England. Love in winter-time is the story told over the chimney-piece, and a hundred little tales are whispered in out-of-the-way nooks and corners upon the wainscotings. The buffet, charming in its simplicity, is an admirable specimen of modern furniture. Oak parquetry forms the flooring, and the window on either side of the buffet is filled with non-transparent glass, since they both look out upon the ramparts, which are upon a level with the room the visitor is now admiring. Mounting by the winding stair, lighted at intervals with a slit in the wall duly filled with glass in an iron frame, the visitor reaches a bed-room which Lord Bute will probably but rarely use. A bath-room, lined with alabaster, containing a bath in the same material, is attached to it. The furniture, to be ultimately placed within it, is represented by rough models of a toilette-table, a bed and a washstand, each to be thought-out and carefully drawn to scale before it is confided to skilled workmen. The decorations of the room are peculiar to its owner. As the proprietor of mines of some importance to South Wales, Lord Bute chooses to be surrounded with trophies of the minerals they contain. The form of a jewel, in which is depicted a figure to represent its nature, is in each window. The wall stories are of the precious metals, and twelve glass knobs in the vaulting are significant of twelve precious stones peculiar to the signs of the zodiac. Portraits of celebrated goldsmiths and jewellers are to be recognized at the springing of each vault, and over the chimney-piece is a shield bearing the Bute arms, surmounted by his coronet, while the face of the stone all around it simulates the earth, and is jewelled here and there with polished bits of mineral procured from the Bute estates. Above is the clock-chamber, and above that a kitchen and other rooms, and above all the summer smoking-room, which holds a gallery and is surmounted by a dome, forming, as far as arrangement and decoration go, the most charming *galetas* in England. If nothing else were provided in it, this upper chamber would suffice to warrant the erection of the tower. Love in summer is the story told upon the lintel of the fireplace. Between the ribs of the dome are figures of the four elements; and the former terminate in tracery filled with looking-glass. Glazed tiles, laid in circles, cover the centre of the floor, and a beautiful wrought-iron railing, richly gilt, forms the hand-rail of the gallery. Alabaster, marble, and glazed tiles adorn the walls, and the upper portions of the windows are filled with stained glass. There is yet a moral attached to this incomplete appreciation of a work of art, and it bears upon a subject which cannot be too often drummed into the ears of the many. It is that all these *motifs* and decorations are to Lord Bute's tower what fittings are to ordinary people's houses. You, Brown (the South Wales branch of the Browns), are pleased to sneer at Wodin and Thor, at Love in all weathers, at the elements, at the zodiac and all other signs, at the precious metals which do not belong to you, at all and everything connected with ornament designed in a style with which you are not familiar, and the details of which you do not care or do not know how to decipher. But, pray, when you have made your fortune, how will you decorate your rooms? No love stories on the 'mantelshelf,' only a native slate chimney-piece, which an enterprizing company will convert for you into the semblance of marble. Over it you will put a mirror in a gilt frame, composed of gewgaws filched from the fashions of three of the French Louis. On your walls you will hang paper whereon flowers will bud and bloom in every impossible position. In the middle of your ceiling you will hang a plaster combination of acanthus leaves—a plant which you have never seen, and of which you know nothing. A plaster cornice will be 'run' round the room under your ceiling, and after the latter is completely finished; and thus a cornice, which in Greek, Roman and Mediæval buildings was necessary to receive the ends of the ceiling-joists, will be introduced into your rooms for 'ornament' only. No tiles, no parquetry for you, but deal boards, with knots, splinters and big crevices, rough and uneven, upon which you will lay a carpet (under that another material of a more common description, as well as sheets of brown paper, to protect the carpet from the splinters aforesaid) which will be bedizened with cabbage roses and gigantic

scrolls repeated to satiety over the whole floor of the room. No stained glass, but big frames of plate glass, to be shaded below with wooden, and above with cloth, blinds. No wall stories, but 'pictures' in oil and water-colour, which you will buy at a promiscuous sale, and hang-up according to their shape and the quality of the frame you may choose for them. And very likely all these things, which you are pleased to think 'ornament,' will cost you as much in proportion as the decorative furniture in Cardiff tower has cost Lord Bute."

About this period (1860-70) Burges was engaged on the alteration and decoration of the chapel at Worcester College, Oxford, and in 1870 he was employed by the Marquis of Ripon to design a church, afterwards built at Studley Royal, in Yorkshire, while another church was erected in the same neighbourhood, at the cost of Lady Mary Vyner, from his designs. In 1872 he began the series of drawings and models to illustrate his scheme of iconography for the decoration of St. Paul's Cathedral. He began, about the year 1875, his remarkable restoration of Castle Coch, a ruined mediæval fortress, a few miles from Cardiff. He was also the architect of the Ripon Grammar School; of the Speech Room at Harrow School; of a few houses, including his own in the Melbury Road, Kensington; of a warehouse in Thames Street, and of several minor works. He designed a vast quantity of furniture, jewellery, and like objects which were executed under his superintendence. "He took great delight," to quote Mr. Pullan again, "in work of this class, and he has produced a greater number of chalices, vestments, reliquaries, croziers, mitres and other ecclesiastical ornaments, in good taste than any of his professional brethren. His profound antiquarian knowledge enabled him to complete designs for objects of this character so accurate in style, that they might have come from the studios of old masters of the arts of metal work and embroidery." Mr. E. W. Godwin, F.S.A., writing in *The British Architect* on the 29th April, 1881, thus describes his introduction to, and subsequent friendship with, Burges :—

"The thing that led me to call first on Mr. Burges was an illustration in *The Builder* (May 29th, 1858) I greatly admired : it was a design by him of a fountain for the city of Gloucester, with a bit of the old city as a background. In this I noted a realization of the Middle Ages, such as no modern pencil had in my then very limited experience produced. Even then, however, the influence of foreign art, and especially of early thirteenth-century French art, was manifest, and, from a sternly antiquarian point of view, the scene was less like what we know Gloucester must have been than like some town in southern France or Spain. This and the quite wonderful bird's-eye view of a mediæval seaport town in *St. Simeon Stylites*, it should be remembered, were drawn some time before the appearance of Viollet-le-Duc's works, before Rossetti's illustration to Tennyson's poem of 'The Palace of Art,' and before the admirable mediæval revivals in the pages of *Once a Week* and *Good Words.* His early years as a practising architect were not a little embittered by the want of work. Luckily he was not in any other want, but to find year after year pass-by, and to see men far his inferiors, or even wholly incompetent, receive important commissions, was galling to him, and often would he talk of it to me in tones of bitter disappointment. During this slack time let no student suppose he was idle or desponding. His energy, his vitality, his hope, were never more buoyant than at this period. Though in the way of business there was nothing for him to design, yet he never ceased designing. In his little pocket books, then and throughout his career, the cunning fingers were busy noting down the art longings and thoughts of the yet busier brain ; and of the many lovely works he has left behind him, I know of none to compete in interest with these tiny memorandum books, containing as they do his first ideas of nearly everything he subsequently carried out, and of many a dream beside. . . . . One of his great ambitions was to build a theatre, and when the commission was given him for the new Speech Room at Harrow he was highly delighted in viewing it as a step towards the genuine theatre or play-house that he used to say chaffingly we should 'build together some day.' But perhaps no architectural design interested him more than that he made for the Law Courts. We had many a long talk over its inception in the quiet of his father's house at Blackheath, where we stayed together for about a week discussing and scribbling. I suppose there can be no doubt that, whatever may have been the defects of his Law Courts design, the façades, the clock tower, and the bridge with which he proposed to span the site of Temple Bar, were among the very best efforts of his constructive and artistic ability, and worthy to rank with the best compositions of our age."

Burges achieved considerable reputation as a writer and lecturer. In 1858 he read a Paper, at the Architectural Museum in Westminster, on *The Conventional Ornament of the Thirteenth Century*; in 1862 he read another, at the Architectural Exhibition, then held in Conduit Street, on *Pagan Art*. In 1867 a Paper by him, entitled *Our Future Architecture*, was listened-to with rapt attention by the members of the Architectural Association, and in 1875 another of his, on *Things in General*, was delivered to the same body. In 1862 he was Cantor Lecturer at the Society of Arts, his subject being "the Applied Arts." He published some of his continental sketches in a folio volume, which was issued to subscribers at the close of 1870, and being limited to a certain number of copies, is now out of print; the book, entitled *Architectural Sketches*, was dedicated to the late Lord Carrington. At the General Conference of Architects held in 1876, he contributed a Paper on *The importance of Greek Art and Literature to the practice of Gothic Architecture*; it was never printed in the TRANSACTIONS, and is therefore here published for the first time:—

In the first place let me say a few words as to the present state of architectural art. If we take up any of the architectural publications, of which there are no less than four weekly ones, we are simply astonished at the number of various styles which are all being practised concurrently. There probably never was such a complete architectural masquerade as we see at the present time. The history of this state of things is not a little curious, and shows how important a part literature has played in this development.

Although Greek architecture was known and described a hundred years ago, it was little practised until Lord Byron published his poems and made us all Philhellenists. Then came Sir Walter Scott with his quasi-mediæval romances, which caused the Gothic revival to set in: the last phase—the Queen Anne style (as it is called)—being due to the works of Thackeray.

It was quickly found that the Greek style was unsuited to our habits, and still more to our climate; but these considerations did not apply to the Gothic revival, which consequently made a deeper impression, and lasted, and I hope will continue to last, very much longer. Some very few years back we were threatened with a Classic revival—a revival freely predicted by the gentlemen who do us the honour of more or less instructing us in the columns of the architectural press. The so-called Classic revival has resulted, however, in the Queen Anne style, than which nothing can be less classical, while its practitioners are simply deserters from the Gothic school. The real reasons for the adoption of this style are: 1. It is easier to design; 2. It takes fewer drawings; 3. It is very cheap, being, in fact, little else than the ordinary house with high-pitched roofs, white clumsy sashes and bars, with sundry rubbed-brick scrolls over the doorways and other parts it may be wished to ornament.

Now these are certainly great advantages, but how about the art? As Mr. Ruskin would say, does the architect love his brick-scroll when he has done it? In future times, when it is a question of a new street, will any one of the buildings in question be spared by the Board of Works because it is beautiful? I think not. We must always take into consideration not only what we ourselves think of a building, but what posterity will think of it, and this brings me to the subject of this Paper, viz., that if these deserters from the Gothic school had studied Greek art and Greek literature, as they ought to have done, they would not have drifted into their present very questionable style. It is true we may all, more or less, have to build cheap edifices; but then we can generally make them picturesque in their outline. This, indeed, the school in question has done; but cheapness does not of necessity involve bad art, and there can surely be no necessity to perpetrate the broken-backed scrolls and false little pediments. Just for a moment imagine an ancient Greek brought to life again and shown these buildings! What would he think of the unnecessarily ugly details?

It is as a cure for this state of things that I would most earnestly recommend a careful study of Greek art and Greek literature to my Gothic brethren. It is really the key to the position; but in studying Greek art it will not be sufficient to consult Stuart's "Athens" and other like books. The actual buildings must themselves be visited. A journey to Athens and back can be accomplished within three weeks, or at most a month, leaving a week for the Acropolis itself. It was not until I was actually on the spot that I understood how beautiful Greek architecture was, and how nearly it was allied in spirit to that of the thirteenth century. From that time I took a new view of the latter art, and things which had before appeared arbitrary and confused

became clear and logical. I saw the same mind working at Athens as at Chartres, but in a different climate, under different conditions, and with different material.

I had been told that Greek architecture was beautiful; but I could not believe it, for I had only seen it represented in books, where the white columns were shaded until they looked like those, thickly-coated with soot, on the outside of St. Paul's. It was impossible to believe that these things could be beautiful; but on the spot itself they were very different, and I saw that, dry bones as they were, the climate, which afforded the broad lights on their surfaces, and furnished the glorious blue sky which formed the background, made every difference. I also saw that each building was placed with the most consummate art, and turned exactly in the direction where it would be seen to the very best advantage from certain points of approach.

Further investigation showed traces of the colour, which, by artfully-designed ornaments, principally in bright tints and thin lines, softened down the intolerable glare of the white marble when first the edifice was built. It is a curious fact that colour thus applied upon a bright surface loses at a distance not only, as might be expected, its individuality, but also gives a light tint of its prevailing colour to the marble. Of course there were other parts coloured in greater masses, such as the triglyphs, which would be seen as local colour even at a distance. The next information was obtained from Mr. Penrose's book. From this I learnt how by almost invisible corrections of the lines of the architecture the same softness was given to a hard marble building as we see in a sketch. Everybody knows how a design always looks better in a sketch than it does in a careful drawing (I am referring to geometrical drawings), and how very often the building itself looks even harder than the geometrical drawing, especially if the latter is touched up with stone joints, real or imaginary. The Greeks were perfectly aware of this fact, and provided for it accordingly. I hardly know a more instructive book than Mr. Penrose's—not for the purpose of copying, for the same curves would in all probability not work in again unless under precisely similar circumstances,—but for the purpose of gaining a general view of the whole arrangement, and for showing how the Greeks proceeded in this matter under certain circumstances. I also venture to doubt whether the results were really obtained by the geometrical means shown by Mr. Penrose, or whether they were not due to some simple mechanical instrument, such as a bent lath in the case of the lines, or to free-hand drawing in that of the mouldings. And here I may observe that there are few things so difficult as the designing of mouldings. It is true that books have been published, giving sections of mouldings which have at various times been used in all styles of architecture; but these will not enable the architect to obtain effective results. The section of a moulding is only the means to an end in the actual work. You do not see the section of the moulding; you see the front view, andw hether that section will make an effective front view depends upon the position in which the moulding is to be placed, the amount of light, and the colour of the material. In Greek work, I suspect, the nature of the coloured ornament with which the moulding was enriched had something to do with the shape.

If we look at the Greek statuary we see precisely similar arrangements for making it effective and relieving it with colour: thus a seated figure seen from below would have an inclined lap and short thighs, in order to counteract the foreshortening in the perspective. The same thing occurs in the figures at Wells Cathedral, but Mr. Falkener, in his "Dædalus," declines to believe that the mediæval artists were influenced in so doing by the same motives as the ancients. This deduction is evidently most unjust and erroneous, for it supposes that the men who worked at such places as Wells, Chartres and Rheims had neither eyes to see nor brains to draw deductions. The Greek sculptor, equally with the mediæval master of living stones (as they were called), knew perfectly well from experience that monumental sculpture—*i.e.* that destined for buildings—demands a very different treatment from that destined to be seen closely, and he acted accordingly.

It may be asked how the student of mediæval art can apply the lessons he receives at Athens. I reply that climate, material and construction being totally different between Greece and England, he especially derives the very great advantage of not being able to copy; he must have recourse to that most laborious of occupations, that of using his head; in fact, he will be all the better if he does not make a single sketch. He may, indeed, enter notes in a note-book, but even that he may safely throw away when he has filled it up. The questions he must ask himself are: Why did the Greeks do this? Why did they cut away that stone or add this? Why was this building set at an angle? And when he has resolved such questions at Athens he will find himself very much more competent to resolve similar, but not exactly the same, difficulties when he works on the Classic style of the thirteenth century. It is true in the latter case that the mouldings are deeper; but he will learn to give them a proper quantity of light and shade, and not overdo them in this respect, as was the case in the Early-English style in our own country. It is true that our climate prohibits, to a great extent, external polychromy, more especially that more delicate description which is only suitable for pure delicate substances, such as marble, ivory and alabaster, but he can use colour in the more protected

parts of his work, such as the tympana of the portals; and in the interior statuary, such as the font, pulpits and domes, he can find employment for alabaster and marble, and consequently for the more delicate polychromy. Indeed, I do not quite see but that even the external system of polychromy might be used internally with regard to a room lined with white marble, or still better, with the more delicate-tinted alabaster.

To go into the question of the subsidiary arts, such as engraving, mosaics, enamelling, bronze-work and, indeed, all those little arts which clothe the dry bones of architecture, and render it agreeable, would take too long a time; suffice it to say that the true architect should be able to design and superintend them. To suppose him to execute them would be asking too much. No human life would be long enough to acquire a moderate proficiency. The great duty of the architect is to design his architecture, and to see to its proper execution, as well as to that of the lesser arts.

In acquiring the knowledge necessary for him to do this, nowhere will he find greater help and instruction than in the careful study of Greek art. The vases, the mirror-cases, the gems, the jewelry, all have their instruction to give, more especially in the human figure ; for the ancients had advantages in this respect which were denied to the artists of the middle ages. The Greek saw the nude human figure every day, and all day long ; he also saw it developed in its perfection, for his fellow citizens did not contort the body with tight, ill-fitting garments and ugly shoes ; on the contrary, they took the greatest care of it by means of bathing and athletic exercises. The Greek artist saw the human figure in its natural attitudes, free from all restraint ; he went away and remembered it—a far better way of studying than that from a fixed attitude by an awkward, unintelligent model at 1s. 6d. per hour. The nearest approach to the old state of things is practised, I believe, in the monastic schools of Mount Athos, where, after the pupil has made his study from the model, the said model is removed, and the pupil is obliged to make another study from memory. The mediæval artist was to a great degree deprived of the study of the human figure in its nude state. In this case we moderns have clearly an advantage. We have not the chance that the Greek had of observing it all day long, but we can have models, and it depends on ourselves if we use them in an intelligent manner.

After all we shall fail to gain all the benefit we may hope to draw from works of the ancients if we neglect their literature. In the middle ages it was not neglected : it is true that Greek art was but little read, but educated men were perfectly familiar with that of Rome. The works of Chaucer, Dante, Petrarch, of the author of " Le Roman de la Rose," and many others, all abound in classical illustrations, and how many more advantages have we who have the whole of Greek literature at our disposal. I do not mean to insinuate that the architect is to be expected to read all the Classic authors in their original languages. Few of us have the advantage of a college education. Art is too long and too difficult to allow three or four years to be subtracted from our best and most teachable time. The little Greek learnt at school is soon forgotten ; perhaps it was only presented to us under the form of small portions of Xenophon, Homer and Euripides, our recollections of the tragedies being principally composed of the particles and accents.

On the contrary, our education proper begins when we leave school, what we have learned there being only a preparation for it. There are excellent translations of all the best authors, and by reading concurrently two or three translations (one probably metrical) we can end by having a very fair idea of the author. I do not mean to infer that the mediæval authors should be neglected ; on the contrary, they should be read concurrently with those of the ancient world. There is wonderful similarity of feeling, for instance, between Herodotus and Froissart, much as there is between Greek and thirteenth-century architecture. Aristophanes and Rabelais are another instance of working on similar lines. The great use of the study of literature to an architect is not only to educate him, but to give him that judicial power which is called good taste. Literature itself will not do this, but it will help. Among other helps is the seeing of beautiful things, which also includes the surrounding yourself with them, and, above all, the study of the human figure.

These things are the more important as the question of art and taste is becoming more prominent every day ; in fact, it is *the* question. If we are ever to have a style in architecture, it will certainly not come from the exclusive choice of any of the existing ones, neither will it come in our own time, although certain writers, as early as thirty years ago, were calling out for no copying, but for the creation of a new style. They might as well have asked for the millennium. Nobody ever can, or ever will, invent a style ; it must come by common practice and common consent. In the meanwhile we may help it on by becoming better artists, and being better read. No one can predict how the new style will be evolved, or when it will come. Perhaps some day we may wake up and the law of leasehold may be abolished ; then it may be discovered that it pays to make what is our own—say our house or our warehouse—the best of its kind. Then may follow the consideration that dirty brick and decaying stone are not the most suitable materials in a city like London, with its atmosphere saturated with gases ; then may follow the reflection that granite, porphyry and majolica are the only substances

which will resist the said gases. But majolica can be decorated and painted and made to tell histories, and to speak like the living stones of the mediæval artists, and then, if we have not neglected our opportunities, and if we have studied the arts—both the great and subsidiary—in a monumental spirit, then indeed we may see the beginning of a new style, a style founded upon common sense, and construction in our own materials combined with beautiful and monumental art.

Some interesting particulars and a thoughtful review of Burges's career appeared in *The Builder* on the 30th April, 1881. The following is an extract:—

"The place which Mr. Burges has taken among contemporary architects has been an unusual one, not only in the nature and extent of his abilities, but in regard to one point to which, in the interests of what may be called the highest morality of the profession, we wish to draw special attention. He has been honourably distinguished by a characteristic which we regret has not found more examples among those of the first order of ability in the ranks of modern English architecture, namely, in his obviously strong feeling as to the importance of making his work really and in every sense his own work, and not carrying-out more than he could give his own personal attention to and produce as his own personal design. We referred in passing to the interest which he took in the decoration of Worcester College Chapel. We alluded to this because we happen to have under his own hand his remarks as to the way in which this work was carried out. In a letter to the conductor of this journal, dated May 7th, 1866, he said,—'I designed everything in the chapel, and I made full-sized drawings for the lectern and candelabra. Mr. Jacquet, of Stanford-street, Vauxhall Bridge-road, executed all but the sculpture. The latter was done by Mr. Nicholls, of Hercules-buildings, Lambeth, under my direction. He also executed the four statues of the Evangelists. I did not make drawings of the sculpture, but I supervized it. Both the candelabra and lectern were drawn out full size by my own hands. As to the rest of the work, in the coloured part I made careful sketches to ½-in. scale of the colour and ornaments, and corrected the full-sized ones when drawn out by the decorator. We spent about 3,000*l*. in all. The mosaic for altar-piece is in progress, and I could have a mosaic for the rest of the pavement, but I rather think a marble pavement will be better.' Probably those who are acquainted with Mr. Burges's manner of working will be aware that this extent of personal work with his own hands, and of careful supervision of every detail as it proceeded, was nothing beyond his usual degree of care and attention to everything he undertook. Mr. Burges had nothing like the extended practice of some of his distinguished contemporaries, but we believe he could honestly say that whatever he did was his own, and bore the impress of his own personal design and taste. In carrying-out work in this way, it appears that there is far more of real architectural art likely to be produced than in carrying-out an immense number of buildings with the help of a numerous staff of draughtsmen who have acquired the style of the office in which they work; a system which must inevitably lead, as it has led in many instances, to work being done in a semi-mechanical manner, up to a general level of excellence perhaps, but not with the interest and variety which can only arise from work which represents individual thought and individual design. And in regard to this feature in Mr. Burges's character and practice as an architect, we would hold out his example to the younger aspirants in the profession, and say, 'Go ye and do likewise.' It is not the way to make a great deal of money, but it is the way to be really an architectural artist, and to produce work which you can look back upon with satisfaction. The general character of Mr. Burges's work is marked, as we observed, by a strong preference for forms based on French Gothic,—so strong as to give to his buildings a character rather at variance with English architectural feeling. For this reason he would not, we should say, have made a good 'restorer'; he could not have kept his own idiosyncrasies of taste in the background sufficiently. This, we think, is apparent in his treatment of the east end of Waltham Abbey, which we could not regard as a success, and which does not seem at all to belong to its position. For a somewhat similar reason we could not regard his design for the decoration of St. Paul's as successful, notwithstanding the unquestionable ability and conscientious thought and study which it evinced. He could not throw himself into a style the details of which he disliked, nor even into anything really consonant with the *genius loci*. As a compromise between his own inherently mediæval tastes, and the obvious necessity of harmonizing his scheme to some extent with the architecture of St. Paul's, he fell back on Byzantine elements of design. But his design would have clashed with the real architectural feeling of the cathedral, and had it been carried-out he would have made a quasi-Byzantine interior to a thoroughly Renaissance building. The work would have been, evidently was, in fact, in the models and drawings, full of power and effectiveness in itself, but we cannot believe the result would have been approved by any who feel the importance of architectural consistency of style and feeling; and this conclusion we felt compelled to express when the models and drawings were exhibited. In Mr. Burges's designs for original buildings the marked characteristics

were force and massiveness of general style and composition, combined with great picturesqueness of detail. His Law Courts design was a remarkable example of this. It was too square,—we might have almost said, too grim and stern,—in its general aspect, and strongly feudal character; but the treatment of the detail bore the impress of great power, and a contempt for everything slight or filagree in style. It would have been a building which no one could have seen without being impressed by it, though most spectators might have felt that it was not in keeping with the intents and associations belonging to modern Law Courts. In his Cork Cathedral, the French style which he adopted seemed not out of keeping with the stern character belonging to the few remains of ancient Irish architecture, and, in the interior, it is a very grandly and massively treated cathedral. This same feeling for stern simplicity of general composition characterized smaller and less important works equally. We were struck with it particularly in some of the drawings of (if we remember rightly) the stable buildings for Cardiff, which were in the architectural room of the Academy one year, and which were as different from the kind of tame 'dove-cot' character habitually given to buildings of this class in England as anything could be, and yet appeared in no way out of keeping with their use and position. Indeed, we should be disposed to say that Mr. Burges's domestic architecture, on a large or small scale, was his greatest success. He removed this class of architecture, in his treatment of it, entirely above the commonplace of house-building (notably so in his own house), and made it an opportunity for the richest effects of internal decoration, in which, where he was not cramped by considerations of expense, he shrank from no amount of richness and elaboration. Some of the drawings of interiors at Cardiff which have been exhibited at the Academy will occur to every one as examples of this. In his designs for furniture we have thought that he was often too indifferent to outline and too dependent on colour for his effects, and that the colour was often too strong. Mr. Burges suffered from weak sight, and, since the effect of personal peculiarities of vision on the estimate of colour has been canvassed a good deal by scientific writers on art lately, we may be pardoned, perhaps, for the suggestion that possibly his own colour schemes may not have appeared so strong to him as they did to others. Except as to this question of relative force or subordination of colour to the effect of the whole, however, he was a master of the use of colour, and knew how to produce his colour-harmonies without falling back on dull and neutral tones, or as he once said sarcastically in a Paper read at an architectural meeting, 'putting a background of dirt' as a ground for the principal colours. Colour with him was colour, and not neutral shades; only there was perhaps a little too much of it sometimes to allow sufficient repose for the eye. Of Mr. Burges's thorough earnestness in what he did, and his close study of his art, there can be no question. The volume of 'Sketches' we alluded-to above was a striking instance of this. They were not pretty sketches—some people called them ugly—but they were sketches made with the intention of getting at the heart of the detail that was sketched, finding out how and why it was made,—sketches which were not fair-weather work, but made, as he said in his preface, often on the top of ladders, with stumps of pencil, on paper wet with rain and held down against the wind (we quote from memory, but that was the purport of the words)."

The writer in *The Builder* is accurate enough in the spirit of his quotation, but he has confused two books. It was the present Secretary of the Institute who, in an attempt to refute certain statements made in *The Quarterly Review* under the headings of "The State of English Architecture," "The Completion of St. Paul's," and "The Hope of English Architecture,"‡ so referred to Burges. "I take leave," said Mr. White, "to correct a false impression of this architect, which the public may have formed from reading *The Quarterly Review* and other publications. Mr. Burges is not a 'sketching draughtsman'—not clever, in a professional point of view, with his 'pencil and bow-pen.' His innumerable drawings, made during long tours in different and remote parts of Europe, are not pictorial effects; but rough diagrams, drawn with pencil stumps to scale with a foot rule, on the top of ladders and in dark corners of vaulting and roof. They resemble rather the sketches of a mediæval architect than those of a pupil of a school of art. True, like Wilars de Honecort, he has a vile habit of drawing the human figure, and this must be left to the generous forbearance of reviewers." What Burges said of himself may here be quoted as illustrative of his early career, and the opinions he held about picturesque sketching and the like. In the *Introduction* to his *Architectural Sketches*

‡ See the TRANSACTIONS, 1874-75, page 63.

occur the following passages:—" After my pupilage I went abroad with sundry of my friends . . . . each of us tried how many more sketches he could make in a day than his companions. On our return home these sketches were cleaned up . . . . and reserved, as a very cynical friend used to observe, ' for the inspection of parents, friends and idiots.' I am ashamed to say how many scrap-books I filled with the sketches made during a few autumns, and at this point, under ordinary circumstances, I should have stopped. I had passed my pupilage, I had taken my foreign travel, and I should have gone into practice with these sketches as my stock-in-trade. Luckily for me, my cynical friend did not cease to ask why I drew this sketch? of what practical good was that detail? why had I not drawn the full-size curves of some particular moulding? and in fact he asked me so many questions, and such embarrassing ones to answer, that at last I was obliged to confess that the sketches had been drawn for the vanity of making pretty sketches; that they were useless, or nearly so, for the information they contained, and that the true destination of all such sketches should rather have been the paper basket than the scrap-book. At this period it so happened that I had the opportunity of seeing Italy, and of being absent from England for a year and a half. I forthwith made up my mind to turn over a new leaf, and to take this opportunity of measuring and, as it were, dissecting the best French architecture of the thirteenth century I could find. To do this I divided my time into two parts; some of it was spent in Italy, but the greater part was devoted to France. . . . . On my return to England I had a very different collection of drawings than that which resulted from my former travels. The inaccurate and often careless sketches had given place to documents; but it must be confessed that these latter had but little attraction to the outer world. A heap of rough cartridge-paper of different sizes, blotted with ink, stained by the rain, sometimes lined with pencil, sometimes with indelible brown, and often with common, ink, presented but few temptations to paste into expensive sketch-books. But to myself they were very valuable, for they taught me the why and the wherefore, which is the base of all architectural knowledge; so they were put into strong working bindings, and thus they remained in my bookcase till the year 1864."

It has been said by more than one British architect of experience, by no means disposed to admire such buildings as Cardiff Castle, that Burges's work was distinguished from that of all his colleagues by the amount of thought displayed in it. The architects who sat on the jury for the Lille Cathedral (Notre-Dame-de-la-Treille) Competition seem also to have admitted this, and the judgment of Didron the elder, given in the *Annales Archéologiques*, was no small compliment to Messrs. Clutton and Burges, and through them to the English school of mediæval revival. Writing on the designs submitted in April, 1856, for the Cathedral of Lille Didron said:—

" Il y a des artistes qui prétendent que l'archéologie coupe les ailes à l'invention; nous soutenons, nous autres, que cette science fait pousser les plumes plus grandes et qu'elle crée, en outre, l'atmosphère où les ailes peuvent se déployer librement et tout à leur aise. MM. Clutton et Burges nous ont donné si parfaitement raison en présence des nullités, des pauvretés, des banalités qui foisonnaient dans la plupart des projets de Lille, que je serai généreux en n'insistant pas davantage. Un fait piquant s'est produit dans le jugement du jury; je crois utile et peut-être même indispensable de le signaler. Le projet de MM. Clutton et Burges est surtout un projet archéologique, et sa grande originalité repose sur l'iconographie beaucoup plus que sur la partie architecturale. Il semble donc que les archéologues du jury auraient dû être frappés, plus vivement que les architectes, des qualités saillantes révélées par nos deux amis. Mais la loi des contrastes, qui gouverne l'univers, est si puissante et si tyrannique, à ce qu'il paraît, que le fait opposé

s'est produit. Les archéologues ont obstinément donné leur voix à d'autres projets où l'architecture paraissait avoir meilleure mine que dans les dessins de MM. Clutton et Burges ; les architectes, au contraire, ont voté avec non moins d'obstination pour le projet archéologique, et ils ont voté avec bonheur, avec succès, puisque le premier prix est échu au projet '*Fœderis arca.*' Messieurs les architectes du jury ont déclaré, il est vrai, et peut-être l'ont-ils prouvé, que l'architecture de ce premier prix était plus intelligente et plus savante, plus sage et plus solide, plus conforme au programme et à la série de prix, plus facile enfin et moins coûteuse à exécuter que celle de tous les autres projets sans exception. Quoi qu'il en soit, ce sont les architectes du jury qui ont déterminé et emporté le vote, et ce vote a couronné un projet archéologique ; quant aux archéologues purs, ils sont parfaitement innocents de ce résultat, et leurs voix se sont égarées ou perdues sur des projets où l'architecture brillait en beaux et magnifiques dessins. . . . . .
Quant à moi, individuellement, mon jugement est celui-ci : tous défauts et toutes qualités compensés dans les divers projets de ce concours, c'est à M. Lassus que j'assigne hautement le premier rang. Mais si l'on place l'architecture en seconde ligne et qu'on s'attache surtout à l'ornementation, à l'ameublement et, plus spécialement encore, à l'iconographie, c'est à MM. Clutton et Burges que je donne la palme. Je serre donc ici bien cordialement la main à mes deux amis, et je leur déclare qu'ils ont réalisé, en grande partie, l'idéal que je nourris depuis longtemps. Personne autre, en France, en Allemagne, en Angleterre ou en Belgique, n'est, au même degré, doué de ce que je me permets d'appeler le génie de l'iconographie chrétienne."

In the "Compte-rendu du Concours," that is to say, the Report of the Assessors for the Lille Cathedral Competition, the successful design is referred-to in the following terms:—

"Enfin, Messieurs, nous terminons cette longue revue en offrant la palme enviée au projet *Fœderis Arca.* Distinguons ici l'œuvre du constructeur et celle du décorateur, celle de l'architecte et celle de l'archéologue. Si les dispositions architectoniques n'ont pas été toujours prises avec tout l'énergique élan remarqué dans le projet precédant *(that of Mr. Street)*, l'artiste s'est montré constamment dirigé par une sagacité profonde et un sentiment élevé de l'art. En choisissant un procédé de dessin trop archaïque, il a dû renoncer à flatter les regards ; mais, nous devons le dire, plus la composition a été approfondie et plus les membres du jury, familiarisés avec les lois de la construction, se sont plûs a rendre hommage à une habileté supérieure. En même temps que les combinaisons de l'art de bâtir se faisaient apprécier par une admirable mesure, la partie de l'ornementation provoquait notre intérêt par l'originalité la plus piquante, et un luxe d'idées que nous eussions en vain cherché ailleurs. L'auteur a fait preuve, dans les détails, d'une science archéologique et d'une habileté de main de premier ordre. Examinez sa chaire si caractéristique, ses fonts baptismaux d'un symbolisme si neuf, l'autel et le *ciborium* aux lignes si nobles, aux ornements si gracieux, et le pavé d'un dessin si etudié et si riche ; partout se fait jour la même fécondité d'esprit, partout circule une sève poétique, comme intarrisable. Honneur à l'artiste anonyme qui a su dans un concours tellement nombreux, au milieu d'une lutte si bien disputée, remporter un de ces triomphes qui jettent un rayon de gloire sur toute une carrière."

William Burges was made a Fellow of the Institute in 1860; the same year he contributed a Paper on *Architectural Drawing,** and he frequently joined in discussions† upon the Papers read at the Institute by his friends and colleagues. His proposed School of Art for Bombay was described by himself in a short Paper.‡ He died on the 20th April, 1881.

*** Since the foregoing notes were in type, a Paper on Burges's works has been read by Mr. R. P. Pullan. This will be found in the present volume.

MARQUIS CAMPANA DE CAVELLI, *Hon. & Corr. Member* (Rome).

GIOVANNI PIETRO CAMPANA remained for thirty-five years an Honorary & Corresponding Member. His death occurred in Rome on the 10th October, 1880, at the age of 72 years. That he maintained to the last his early energetic enthusiasm for archæological research is shown in a letter addressed on the 26th October, 1879, to the

* See the TRANSACTIONS, 1860-61, page 15.
† See a characteristic speech by him on "Colour," in the TRANSACTIONS, 1857-58, page 55.
‡ See the TRANSACTIONS, 1867-68, page 83.

late Mr. T. H. Wyatt, wherein he says, writing in French, "Je ne manquerai pas de vous renseigner . . . . des nouvelles découvertes d'antiquités dont le sol Italien et Rome notamment sont une mine inépuisable. Cette espérance est d'autant plus sérieuse de ce que j'ai en projet de donner suite à des fouilles sur une assez vaste échelle à la recherche d'anciennes villes de Latium, antérieures à la fondation de Rome, sans négliger l'exploration des monuments classiques du temps de l'Empire Romain, gisant dans l'enceinte même de la ville éternale!" The correspondent of *The Times,* in Rome, after a brief mention of Campana's excavations some twenty-five years ago among the remains of the cities and cemeteries of Etruria, refers to his early career, thus:—

"While still a young man he was recognized as one of the most distinguished archæologists of the day; but his love for the science and his intense passion for collecting became also the cause of his ruin. Appointed director of the Monte di Pietà by Gregory XVI., he availed himself of the faculty of that establishment to lend money on works of art and objects of antiquity by borrowing largely, in his own person, on the security of the contents of his museums. Accused of malversation, he was brought to trial and condemned to a long term at the galleys; for which imprisonment was substituted. The justice of this sentence was the subject of considerable discussion at the time. It was asserted that Gregory XVI. had granted Campana permission to borrow money in his private capacity on the security held, and that he was the victim of the enmity of Cardinal Antonelli, who desired to place, as in fact he did, one of his brothers at the head of the Monte di Pietà, as he had obtained for another the direction of the Banco Romano. It was admitted that Campana had certainly abused whatever privileges may have been granted him by absorbing to his own use a disproportionate share of the capital of an establishment intended for far wider circulation; but the sentence was considered exceptionally severe for the reason that no really fraudulent intentions could be imputed to Campana, and that his magnificent collection, immediately dispersed at a reckless sacrifice, realized a large sum in excess of that he had borrowed. After remaining for some years in the prison of San Michele, where he was attended with most exemplary devotion by his English wife, he was finally liberated at the urgent intercession of Napoleon III."

The same correspondent renders justice to Campana's memory by quoting from the *Voce della Verita* a paragraph which he thus translates:—"In the midst of the vicissitudes of his life he preserved the serenity of his mind and the tranquillity of his spirit. He never abandoned those severe studies to which he had dedicated himself from his youth, particularly that of archæology, in which he was eminently deserving, on account of the valuable works he brought to light and the importance of the collections which, with a constancy equal to his ardour, he succeeded in forming."

GABRIEL JEAN ANTOINE DAVIOUD, *Hon. & Corr. Member* (Paris).

IN THE ADDRESS delivered by M. Bailly, the distinguished President of the Société Centrale des Architectes, over the tomb of Davioud, on the 8th of April, 1881, two days after his death, the deceased architect is described as one of the best pupils of the late M. Léon Vaudoyer, whom he aided in the latter's remarkable historical Essay upon Architecture in France. Born in Paris on the 30th October, 1824, he entered, at the age of fourteen, a school of design, where in the course of three years he gained forty-four prizes, and then was admitted to the École des Beaux-Arts. There at the age of twenty-five he obtained the second *grand prix de Rome* (1849), but, though he had five years before him in which to compete for the *grand prix,* circumstances compelled him to relinquish his chance and engage in the active practice of architecture. His means were insufficient to allow him to continue

his studies at the École des Beaux-Arts, where, however, he had remained some seven years, and obtained the highest award that could be given for a study in polychromatic decoration, the success of which is ascribed by M. Bailly to the example and archæological learning of Hittorf, under whom Davioud worked at the Mairie of the Twelfth Arrondissement, Place du Panthéon, in the year 1847. He was *Inspecteur*, that is to say architect-clerk of the works, at the Halles Centrales, constructed under the superintendence of the late M. Baltard; and he was successively *Inspecteur* at the Schools of the Rue Sainte-Croix-de-la-Bretonnerie, and of the Faubourg Saint-Martin.

The first building obtained in competition and erected by Davioud, in 1850, from his own designs was the little Théâtre d'Étampes, and a few years after, the opportunity occurred which enabled him to devote his talent and energy to the work of improving, demolishing and reconstructing the French capital. At that time, 1855, a special Service was established and placed under the chief direction of M. Alphand, who, after more than a quarter of a century, still holds the distinguished position of Directeur des Travaux de Paris. Davioud was appointed in the first instance Inspector and afterwards Architect in the Service des Promenades et Plantations, and his appointment was due to the sketches he made for the lodges and gates ultimately erected at the various entrances to the Bois de Boulogne, sketches which at once attracted M. Alphand's attention. It is consequently to Davioud that the designs of the many châlets, cottages, kiosques, cafés, restaurants, and other rustic constructions in and around the Bois de Boulogne, are principally due. In conjunction with M. Bailly, he erected the Grand Stand, Pavilions and other buildings connected with the well-known race-course at Longchamp. The fountain in the Avenue de St. Cloud, the Fontaine Saint-Michel, the Panorama building in the Champs Élysées, the two theatres in the Place du Châtelet, the two fountains in the Place de la Madeleine, were all his; and he restored the Fontaine des Innocents. The designs for the iron railings which year after year caused a new surprise to the English visitor—he was struck with their originality and boldness—in the parks and squares, formed or enlarged or inclosed during the brilliant period of the Second Empire, were from his prolific pencil. In fine, during fifteen years, all those petty architectural embellishments of which few stop to inquire the name of the author, which combine to render Paris the most finished of great capitals, may be fairly ascribed to the genius and devotion of Davioud.

During the war of 1870-71 he was captain-commandant in the Corps du Génie Auxiliaire, and served under M. Alphand and the late M. Viollet-le-Duc, who were the colonels. After the war, the Service d'Architecture of Paris was entirely reorganized, and Davioud became Inspector-General. A little later, a further change took place, and after thirty years' service Davioud retired with the title of Honorary Inspector-General.

Apart from his administrative works, he won in competition the first premium for a monument to be erected at Lisbon, and the second premium for one to be erected at Callao. He was one of the architects distinguished by the jury in the great competition for the new Hôtel-de-Ville, and, in conjunction with another, gained the second premium in the competition for the Church of the Sacré-Cœur at Montmartre. A Knight of the Légion d'Honneur in 1862, he became an Officer in 1878. He had belonged to the Société Centrale des Architectes from the year 1869, and held in it the offices of chief secretary and of vice-president. He was president of the Société de Propagation des Livres d'Art, a member of the Commission pour

l'Enseignement du Dessin, and a member of the Conseil des Travaux d'Architecture of the City of Paris.

Davioud early distinguished himself as a writer. In March, 1865, when lectures were given at the Union Centrale des Beaux-Arts appliqués à l'Industrie, where archæology was treated by M. Adrien de Longpérier, painting on glass by M. de Lasteyrie, the grammar of the arts of design by M. Charles Blanc, sculpture by M. Aimé Millet, ornament by M. Albert Jacquemart, the subject of architecture and industrial art was treated in four lectures by Davioud. Previous to this he had been directed by the Préfet de la Seine, Baron Haussmann, to visit London for the purpose of studying and reporting upon the various theatres in the British capital, particularly those in which the prices of admission were extremely moderate. His report * was a long one, and is still well worthy of consideration by the metropolitan authorities, though seventeen years have elapsed since it was written. He stated that Covent Garden Theatre was perhaps the only theatre in London built under conditions similar to those prescribed by the proper authorities in France. In the majority of cases he noticed that the wall separating the stage from the auditorium was constructed of "maçonnerie légère," that the floors, roofs, galleries, fronts of boxes, internal partitions were invariably of wood; and he was far from thinking that theatres in London, where few restrictions existed, were better constituted for the use of the public than those newly erected in Paris in accordance with government regulations. He made it perfectly clear throughout that in this country speculation was the unique aim and end of theatrical enterprize, and that it was an axiom of government to leave theatre-goers to take their own chance as to being burnt alive or poisoned, within all or any of the various buildings dedicated to the cultivation of music and the dramatic art. He gave as a justification for the high prices of admission to theatres in Paris the following reasons: (1) the cost of the site was greater in Paris than in London; (2) the police obligations, which ordained an allotment to each spectator of a larger area of space than English speculation did; (3) those same obligations, which did not allow theatres to be erected except in a costly and in some sort monumental manner, as much from the point of view of the safety of the public as of that of neighbouring property. Referring to the ordinary London theatres, he said, "Nés d'une pensée de spéculation, ils satisfont à des besoins, et le moraliste seul peut dire si leur présence a servi à la cause populaire." But turning thence to the higher class of London theatres, corresponding with the "théâtres de luxe" of Paris and the great French cities, in which, said Davioud, "le monument doit être en rapport avec les œuvres littéraires ou musicales qu'on y interprète, on est forcé de convenir que l'Angleterre est loin encore d'être le pays des arts et du comfortable appliqué à la masse des individus." Some years after this report was made, Davioud prepared a Paper on the form of *Salles de Spectacle en France et en Italie dans les temps modernes*,† prefacing his remarks with an archæological summary of events connected with the theatre and with comedians in the fifteenth and sixteenth centuries, and illustrating a most interesting Paper with sketches of *Salles de Spectacle* in the time of Louis XIII. and Louis XIV., and with plans of the great

* This Report on the London theatres is printed in the *Revue de l'Architecture et des travaux publics*, vol. xxiii. pp. 116, 207 and 244.

† Read to the Congress of French Architects held in 1873, and published in the *Annales*, 1874, of the Société Centrale, p. 168.

theatres of France and Italy, such as those of Bordeaux, Milan and Naples. A short time before the Franco-German war, Davioud, as the principal secretary of the Société Centrale des Architectes, prepared an exhaustive report * on the proper means of increasing the notoriety or influence of the society, the conclusion of which contains nine clauses or recommendations which he offered for the judicious appreciation of his colleagues—clauses which every society of architects may read with advantage. Davioud's speech † over the tomb of Léon Vaudoyer also bears evidence of having been prepared with care, and it is a record of the reverential affection he felt for his master. His report on Public Competitions ‡ was regarded by his professional brethren as an important contribution to the inquiry upon the difficult subject, an inquiry which Davioud re-opened at the International Congress of 1878. At that Congress Davioud read his *Mémoire sur la question de l'union ou de la séparation des ingenieurs et des architectes,* ‖ a work which obtained for him the *prix Bordin*—a prize which he then received for the second time. His last work of this description was an essay submitted in competition to the Société des Études Historiques on the subject of private habitations from the end of the sixteenth century to the year 1830. The essay was sent in under a motto, as required by the conditions, and on breaking the seal, a short time after Davioud's death, it was found that he was the author.

Davioud was elected an Hon. & Corr. Member in 1879, and his connection with the Institute originated partly with himself, he having expressed a wish, through M. Francisque Michel, the distinguished author, to become better acquainted with his British *confrères.*

A decision, taken by the executive of the Institute after the election of Mr. Whichcord as President, to forward the Institute publications to every member throughout the world—a decision previously communicated to the Hon. & Corr. Members in a letter addressed to them by the President and Secretaries, with a request to be favoured with information respecting the state and progress of architecture in their respective countries—was answered by Davioud in terms of courtesy which may well find a place here :—

Paris, le 29 *Août,* 1879.

Messieurs et très-honorés confrères,—J'ai reçu la lettre que comme président, secrétaire honoraire et secrétaire de l'Institut royal des Architectes britanniques, vous m'avez fait l'honneur de m'adresser. J'applaudis de tout cœur à la résolution que vous avez prise d'établir une correspondance entre les divers membres de l'Institut dans le but d'être utile à la pratique de notre art. Je ferai personnellement tous mes efforts pour répondre aux vœux que vous m'exprimez et je vous serai reconnaissant de vouloir bien m'adresser les publications annuelles rédigées sous l'impulsion des illustres confrères composant la société anglaise. Permettez-moi à cette occasion d'exprimer le désir que l'Institut royal britannique se mette en relation directe avec le bureau de la Société centrale des Architectes de Paris, dont le Président, le vénéré Mr. J. B. Lesueur, est membre honoraire de la Société anglaise. Ainsi que j'ai eu l'honneur de vous l'écrire, Messieurs, au commencement de l'année, j'avais l'intention de me rendre à Londres pour remercier mes très honorables confrères et faire connaissance avec eux. Une affaire imprévue m'en a tout d'abord empêché, et plus tard l'état de ma santé, aggravée par les excès de travail de l'année de l'exposition, m'en a interdit la réalisation. Croyez, Messieurs, que c'est avec le plus vif regret que j'ai dû ajourner le bonheur que je m'étais promis, et croyez aussi que je conserve l'espoir de reprendre ce projet aussitôt que je le pourrai. Je comptais porter à l'Institut royal quelques souvenirs de mes travaux. Je prends la liberté de vous les addresser par la Messagerie. Vous trouverez donc dans la caisse que je vous addresse : (1) Deux Plans du Palais de Trocadéro ; (2) La photographie

* See the *Bulletin Mensuel,* 1871, p. 64. † See the *Bulletin Mensuel,* 1872, p. 79.

‡ See the *Bulletin Mensuel,* 1872, p. 52 ; and the *Annales,* 1874, p. 65.

‖ See the volume, published by the Ministère de l'Agriculture et du Commerce, entitled *Congrès international des Architectes,* Paris, 1881, No. 9 of the series, p. 93.

du projet, dressé en 1877 et qui a décidé l'exécution de cette grande construction ; (3) Deux photographies représentant la translation et l'élévation de la fontaine du Palmier sur la Place du Châtelet ; (4) Une photographie représentant la perspective du Théâtre Lyrique et du Châtelet construits en 1860 sur cette Place ; (5) Une photographie de la fontaine St. Michel ; (6) Une photographie de l'une des grilles du Parc Monceaux ; (7) Un exemplaire du petit ouvrage sur le palais du Trocadéro, dont je suis un des auteurs ; (8) Un exemplaire de mon ouvrage sur les Théâtres de la Place du Châtelet. Je serais très heureux si ces divers documents pourraient trouver une petite place dans la Bibliothèque de l'Institut. En ce qui concerne les noms et correspondants futurs de la société, dignes de devenir nos collègues, je vous demande la permission d'y réfléchir et d'en conférer avec quelques-uns. J'aurai l'honneur de vous écrire à cette occasion. Veuillez agréer, Messieurs et chers confrères, l'assurance de mes sentiments les plus distingués.

Davioud, Membre honoraire de l'Institut royal des Architectes Britanniques.

His last and perhaps the most important of his works were the Palais du Trocadéro and the Mairie du XIX^e arrondissement, both carried out in conjunction with M. Jules Bourdais, one of the Government architects. This gentleman, writing in the *Encyclopédie d'Architecture*, (Vol. X., 1881, page 38), thus refers to his deceased colleague :—

"C'est peu avant cette époque (*about* 1873) que j'eus le bonheur d'entrer en relations avec Davioud et l'honneur de collaborer avec lui. Je connaissais jusque-là par ses œuvres l'artiste distingué qui s'était fait une place si brillante dans notre art ; je pus apprécier alors combien chez lui le cœur était à la hauteur du talent. Dans notre collaboration de sept années, Davioud, se désintéressant constamment des intérêts matériels, réclamait toujours avec ardeur sa grande part du travail. En vain, sa santé qui s'altérait sous les coups incessants d'un labeur opiniâtre, faisait-elle un devoir à ses amis et à sa famille de lui commander plus de repos. Son plus grand bonheur était de se trouver à sa table de travail, où son rapide crayon couvrait, presque sans ratures, d'innombrables feuilles sans cesse renouvelées et sans cesse remplies. Il abusait de cette prodigieuse facilité et devait mourir le crayon à la main ! Je laisserai à d'autres le soin d'apprécier le résultat du concours universel pour l'Exposition de 1878, puisqu'il m'a permis de construire, en collaboration de Davioud, le palais du Trocadéro. Pour le même motif je me bornerai à indiquer ici la mairie du XIX^e arrondissement construite en 1876, et qui sera complétée cette année par une salle de fête, que j'aurai le regret d'être seul à construire, d'après l'avant-projet étudié en collaboration avec l'ami qui n'est plus, et dont la place laisse un si grand vide dans l'esprit et dans le cœur de tous ceux qui l'ont connu dans cette intimité de tous les jours qui faisait valoir ses remarquables qualités. Davioud a écrit plusieurs mémoires couronnés par l'Institut, et dans lesquels, la netteté et l'élégance du style faisaient valoir la hardiesse et la nouveauté des appréciations. La mort, qui a enlevé beaucoup trop tôt à l'art qui le passionnait cet artiste distingué, ne devait pas trancher le cours de ses succès. La Société des Études Historiques lui décernait, en effet, en séance publique, le 22 mai de cette année, le premier prix pour son mémoire sur l'Habitation. L'Institut ne pouvait tarder à l'admettre parmi ses membres. Plusieurs fois bien classé par le vote de l'illustre compagnie, il en eût été un des membres les plus actifs et les plus indépendants ; l'élection de Davioud ne pouvait se faire désormais attendre. D'autres, très illustres, avaient attendu bien longtemps cet honneur qu'il ambitionnait si légitimement. Le Destin, qui l'a si terriblement frappé, ne lui a pas permis de subir un si long stage. L'opinion publique n'a pas attendu sa mort pour consacrer son talent et marquer sa place dans l'histoire des beaux-arts de notre siècle."

Davioud's sudden death, at the age of fifty-seven, resulted from a fit of apoplexy; he was attacked at eleven o'clock at night, while engaged in putting the finishing touches to work which he was in a hurry to complete. Passionately fond of his art, to translate the words of his friend, Davioud possessed one of those natures for which the favourite preoccupation is study. The eulogy pronounced at his funeral, in the presence of a large number of colleagues and friends, concluded with an eloquent peroration. "Permettez, Messieurs, à un vieil ami de Davioud," said M. Bailly, "d'évoquer des souvenirs de près de trente ans. A cette époque, il était un tout jeune homme intelligent, brillant par le langage, brillant par l'esprit, brillant par le talent et ayant foi en l'avenir; il voyait déjà la voie à suivre. C'est vers ce moment que nous l'avons aidé à entrer dans cette honorable famille Mercier où il a rencontré une compagne absolument digne de lui, qui, pendant une période de temps, trop courte, hélas ! lui a donné les douces joies de la famille. Il laisse deux filles, l'une

jeune encore, et l'autre unie à un homme qui porte honorablement un nom bien acquis, et un fils de 12 ans qui suivra, je n'en doute pas, la voie si bien tracée par son père. Adieu, cher Davioud; adieu, cher et ancien camarade et ami, reçois au nom de la Société Centrale des Architectes, dont je suis ici l'interprète, les derniers hommages que tes confrères t'adressent; ils conserveront de toi un affectueux souvenir. Puisse ta digne famille trouver, dans les témoignages d'estime pour ton talent et pour ta personne que nous te donnons à ce moment suprême, un adoucissement à la vive douleur que nous partageons de cœur avec elle!"

*** Since the foregoing notes of Davioud's career were in print, a biographical notice from the pen of M. Destors, Vice-President of the Société Centrale, has been received. It forms part of the Proceedings of the Annual Congress of Architects held in 1881 at the École des Beaux-Arts in Paris, and contains an appreciation of the Palais du Trocadéro as a work of architecture which may be usefully recorded here. "C'est un édifice très populaire que le Trocadéro," says M. Destors; "la nouveauté du projet, l'ampleur et l'originalité de la conception, l'emploi des moyens nouveaux, la rapidité de l'exécution, tout cela a vivement frappé le public, et cette voix populaire n'a pas en cela été dépourvue de sens; car, si incompétent que soit ce témoignage, il n'est pas moins l'expression du sentiment de grandeur qu'inspire la vue de l'édifice. Et maintenant quand on examine sa structure, quand on a pu se pénétrer du programme réalisé, n'est-il pas évident, que ce Palais donne satisfaction à des besoins nouveaux? ne sommes-nous pas au temps où tous sont conviés à ces grandes solennités musicales jusque-là réservées à quelques-uns? Les galeries ne sont-elles pas là pour les exhibitions des objets d'art et de science? On y installe aujourd'hui un musée rétrospectif, au moyen de moulages faits sur les chefs-d'œuvre du moyen âge, et les salles des conférences sont là pour les discussions des questions scientifiques ou artistiques. Ces campaniles à la façon florentine n'invitent-ils pas l'étranger à étudier de haut et d'ensemble la topographie de la grande ville? Tout cela a été compris et magistralement interprété. L'avenir jugera le Trocadéro; mais les architectes contemporains sont fiers d'avoir vu sortir de leurs rangs les artistes qui l'ont exécuté."

MARTIN GROPIUS, *Hon. & Corr. Member* (Berlin).

THE DEATH, on the 13th December, 1880, of Martin Gropius, at the comparatively early age of fifty-six, has deprived the German Empire of a foremost architect, who by birth and training was connected with the family of the celebrated Schinkel. He was born at Berlin on the 11th August, 1824. His father owned a well-known silk manufactory, and Schinkel often designed patterns for the higher class silks, while Karl Gropius executed work designed by Schinkel for the Royal Theatres. The closest intimacy subsisted between this family and that of Gottfried Schadow, the sculptor, many years Director of the Academy of Arts in Berlin, as well as with Beuth,* often described as the re-organizer of the German profession of architects. Another constant visitor at the house of the elder Gropius was Karl Bötticher,† who made designs for silk hangings at the Royal palaces, and who was Martin's first preceptor in drawing. While still engaged in his artistic studies, the subject of this notice

* The Chevalier Beuth was an Hon. & Corr. Member in 1842, and he is entered in the List of Members as a Privy Counsellor of the King of Prussia.

† Author of *Die Tektonik der Hellenen*.

had opportunities of acquiring practical experience at the Königsberg railway station, and in the erection of a château near Dresden. He passed an examination as architect in 1854. Appointed to the post of District Architect to the Chief Department of Police he held it for only a short period, and left the Government service for the purpose of setting up as an architect on his own account. This step was a bold one at the time, and the writer of an article in the *National Zeitung* (9 January, 1881), from which most of the information here printed is derived, significantly comments on it. He says that "such a proceeding on the part of a man so highly gifted, possessing every qualification for the post, with an influential connection and much interest in high quarters, was a sign of the times of no trifling import. Of artistic building or remunerative employment for private architects—apart from Government contracts—there was hardly the faintest trace down to the year 1848 in this good city of Berlin; nor did sculpture and ornamental painting attract the patronage of civilians. The one single aim of an accomplished architect was a berth under Government, and if perchance a wealthy citizen had a fancy for something uncommon or picturesque in the way of architecture he would, in the majority of instances, give the commission to officials wholly or partly employed in the Government departments." The result of this independent action was eminently advantageous. The number of private residences erected in Berlin from the designs of Gropius is enormous, and the character of his works has always been imbued with the teachings of that Neo-Greek school of architecture, of which in Berlin he was early a master. Between 1869 and 1874 he was engaged, in partnership with Herr Schmeiden, in the erection of a large hospital, planned on the pavilion system, and since adopted as a model for all similar buildings in Germany. Infirmaries, hospitals, lunatic asylums, schools and institutions of every kind were afterwards erected by the firm of which Gropius was the chief; besides which a large number of designs for all sorts of construction, made under his superintendence, were carried out in various parts of Germany by the Government officials. The building of the University of Kiel was intrusted to him. During 1873-76 he finished the collegiate portions of this edifice, and the Medical and Scientific Schools were terminated in 1880. In another direction many more may be cited, such for instance as the Imperial Banks at Kiel, Erfurt and Stolpe; Insurance Company offices in Berlin, designs for the elevations of Imperial Post Office buildings, &c. He also superintended the construction, in 1872, of the Houses of Parliament in accordance with the plans of Hitzig, whose recent death followed that of Gropius within the space of twelve months. Martin Gropius is also credited with having initiated a pattern plan for University Libraries. His premature death is said to have been indirectly caused by the worry consequent on his labours in this respect, or at least his strength was undermined thereby. The contributor, already quoted, to the *National Zeitung*, describes the seven years story of the Library Buildings at Berlin as a page of woe in architectural annals, though viewed by the light of English experience it seems familiar enough. "Over and over again," says the writer, "were the plans sent back, because the ground (the property of the Royal Academy) destined for the erection of the new buildings, happened to be partly occupied by military barracks, the removal of which could not yet be accomplished. Every effort was made to contrive some sort of feasible compromise, and to make a start with this the most needed and most indispensable of all buildings—were it only partial commencement. Dozens of large sheets, thousands of working hours, expended in the elaboration of designs of astonishing

magnitude, were wasted in vain endeavours. The preliminary work and the journeys which Gropius took, in conjunction with Lepsius, and later with Schmeiden to Paris, London, Vienna and Holland in succession, have since borne fruit to the advantage of our smaller cities, but as to the working drawings for the Library Buildings at Berlin they bewail their forlorn condition on the paper."

The work to which Gropius had lately devoted himself, with unremitting industry and love, he was destined to leave unfinished. The new building for the Industrial Arts Museum, situated in the centre of Berlin, was approaching completion, and required only another summer to fit it for occupation, when Death overtook its architect, to whose exertions, it is now said, the very existence of the building itself, as an institution, is due. He also left behind him his competition designs for the Cathedral of Berlin, for the Palace of the Reichstag, and for the Concert Hall at Leipzig, none of which have been executed.

Martin Gropius was consulted by the Imperial Government in all leading questions relating to art-instruction. In 1867 he assisted in the foundation and organization of the German Industrial Museum, the school of which was arranged in accordance with his plans. In 1869 he was deputed to re-organize the Art Schools at the Academy upon the same model. From that time until his death he held the post of Director of the Royal School of Art, being also a member of the Senatus Academicus. The following extract, translated from an article in the *National Zeitung,* before mentioned—the opinion of a writer undoubtedly conversant with the details of his subject—is worth preserving:—

> "Gropius strenuously opposed the administrative official routine which, up to within the last few years, governed architectural work in Prussia. He combated, to the best of his ability, the prevailing custom of getting architectural government work executed by the administrative departments, who deputed only too often a varied succession of officials—irresponsible from an artistic point of view—to carry out a 'job' as one might appoint a clerk-of-the-works. Artistic building, in his view, must vindicate for itself, as an independent section of the Fine Arts, the same consideration as is accorded to painting and sculpture. If the State have a great building to be erected let the Government intrust it to the artist best qualified for that particular kind of work, and not allow it to be executed by any relative departmental official in the architectural departments of the Civil Service."

Martin Gropius was elected an Hon. & Corr. Member in 1879, and he then presented to the Library a valuable collection of photographs representing his principal works in Berlin and other parts of Germany. Though he had not, in early years, enjoyed the advantages to be derived from foreign travel, never having, as a student, visited Greece or Italy, his name was well known outside the immediate circle of his professional achievements. He was an Hon. Member of the Imperial and Royal Academy of Arts in Vienna, of the Society of Architecture in Amsterdam, and of other cognate European bodies.

HECTOR MARTIN LEFUEL, *Hon. & Corr. Member* (Paris).

LIKE most of the Parisian architects who attain distinction, Lefuel, on his return from Rome, opened an *atelier* for the reception of students, about the year 1844, and commenced the practice of his profession. After the Revolution of 1848 he was appointed by the Government architect to the Château de Meudon (destroyed in 1871), where he was employed in planning and superintending the execution of the gardens pertaining to the château. Transferred thence to the Château de Fontainebleau, he arranged a *salle de*

spectacle in the right wing of the Cour du Cheval Blanc. At the very close of 1854 Visconti,* who had been, for about three years, occupied with the designs for uniting the Tuileries and the Louvre, died of apoplexy. Lefuel was appointed his successor, and the choice of Napoleon III is partly accounted-for in a Memoir of Lefuel prepared by M. A. Normand, and read by him to the Annual Congress of Architects, held in June, 1881, at the École des Beaux-Arts, Paris. This biographical notice, published in April, 1882, contains the following characteristic paragraph:—

"Lefuel, qui déjà à Meudon avait eu, lors de la modification des jardins, l'occasion de se faire remarquer du Prince Président, avait eu avec lui de fréquents rapports, lorsque, devenu Empereur, il habitait pendant l'été le Château de Fontainebleau. C'était souvent le matin, à cheval, dans la forêt, que se traitaient les affaires entre l'architecte et le monarque dans toute sa splendeur, dont rien ne faisait alors présager la fin terrible, et qui était alors plus puissant que celui d'Allemagne qui venait s'asseoir à sa table pour le mieux tromper. Ces promenades avaient fini par établir entre eux une intimité relative qui permit à Lefuel de recueillir l'héritage de Visconti sans aucune concurrence possible."

In 1855, the year of the first Great Exhibition held in France, Lefuel was chosen by the Emperor as his architect, and he held the position until 1870, and that of architect to the Louvre until his death, which occurred on the 31st December, 1880, at the age of 70. A notice of his career from the brilliant pen of M. Charles Blanc,† Minister of the Fine Arts during the presidentship of the late M. Thiers, was published in *Le Temps* of the 20th January, 1881. The following are extracts from it:—

"Nous avons eu dans notre temps deux hommes qui ont représenté l'architecture sous ces deux aspects,‡ avec une haute distinction; c'étaient Duban et Lefuel. Duban, possédé d'un certain génie poétique, songeait aux impressions morales que produirait l'édifice dont il dressait les plans; il étudiait les rapports subtils qui unissent la matière et la pensée. Il cherchait dans l'architecture non-seulement l'utilité pratique, mais l'expression éloquente d'un sentiment. Lefuel, esprit clair, ferme et positif, se préoccupait avant tout du nécessaire et du commode; il était on ne peut mieux renseigné sur la qualité des matériaux; il en calculait la résistance et la pesanteur, et tout édifice lui paraissait bien conçu quand il y trouvait ces deux choses essentielles, la solidité et la convenance, la convenance c'est-à-dire l'adaptation des plans aux exigences de la vie, publique ou privée. Il faut donc s'attendre que, s'il est arrivé à ces deux artistes de commettre quelque faute, l'un l'aura commise dans la construction, pendant que l'autre aura failli à l'endroit du beau. C'est, en effet, ce que nous montrent les ouvrages de ces deux hommes. Duban et Lefuel, qui, dans la diversité de leurs tempéraments, ne sont pas sans avoir quelque similitude, le premier avec Duc, le second avec Vaudoyer.

"Le père de Lefuel était un architecte-entrepreneur qui avait conduit à Versailles des travaux importants, et cela seul explique déjà l'inclination du fils vers la pratique de l'architecture, qui était chez lui comme une science innée. On lui donna un maître cependant, et ce maître fut M. Huyot, excellent professeur, qui était par-dessus le marché un homme d'esprit, et j'en dirai tout de suite une preuve. Un jour qu'une commission dont il faisait partie était réunie dans la cour du Louvre pour décider si l'on mettrait au centre de cette cour la statue équestre du duc d'Orléans, ou la fontaine des Innocents, ou tout autre morceau, Huyot laissa tomber cette parole: 'Si nous ne mettions rien? . . . J'ai remarqué que rien fait toujours bien en architecture . . .' Mais, de plus, Huyot était un artiste aux idées larges, qui avait beaucoup vu, beaucoup voyagé, et qui de ses pérégrinations en Grèce, à Constantinople, en Asie mineure, en Égypte, avait rapporté des notions justes sur l'architecture antique. Il fut, je crois, le premier dans ce siècle qui explora les monuments

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* Visconti was an Hon. & Corr. Member, and presented to the Institute a copy of the work showing his design for the completion of the Louvre. A description of his appointment as architect of the new works of the Louvre, given by himself to Professor Donaldson, is published in the TRANSACTIONS, 1853-54, pp. 32, *et seq.* At his funeral, barely two years after his appointment, the then Minister of State, Count Xavier de Casabianca, publicly stated that "Quel que soit l'honneur réservé au successeur de Visconti, la gloire d'avoir conçu et assuré l'exécution appartient désormais à cet homme aussi modeste qu'éminent."

† A member of the Institut de France, deceased the 17th January, 1882.

‡ M. Blanc had previously referred to architecture "being a science at the same time as an art."

d'Athènes; mais il y a un temps pour voir les œuvres du génie humain, et un temps pour les comprendre. Ce temps n'était pas encore venu.

" En 1833, Lefuel, âgé alors de vingt-trois ans, concourut pour le prix de Rome, mais il n'obtint que le second grand prix. Il remporta le premier, en 1839, la même année dans laquelle Gounod eut le grand prix de musique, et Ernest Hébert le grand prix de peinture ; l'Académie de France à Rome avait alors pour directeur M. Ingres qui, par l'élévation de son talent et par sa brusque humeur, exerçait sur tous les pensionnaires une influence considérable. Sous sa direction, j'allais dire sous son pontificat, on travaillait gaiement mais sérieusement et beaucoup. Lefuel, en particulier, paraissait doué d'une puissance extraordinaire de travail et de volonté. Plus riche que les autres, il s'était fait de son logement de pensionnaire une habitation comfortable, meublée avec goût, et comme il n'y avait pas alors de salon à la Villa-Médicis, on se réunissait de préférence chez Lefuel pour prendre le soir une tasse de thé, en causant d'art et de tout, et de mille autres choses. Là des amitiés se formèrent pour la vie, et personne n'y fut plus fidèle que Lefuel. Hébert, alors en cinquième année, était allé à Florence pour y étudier les maîtres primitifs. Un jour qu'il marchait sans précaution sur une dalle couverte de verglas, il tomba et se cassa une jambe. Averti de ce malheur, Lefuel partit incontinent pour Florence, vint s'installer auprès de son ami dans une chambrette, *via dei Cauzaiuoli*, et, bien résolu à ne pas quitter jusqu'à la guérison du malade, il eut la constance de dessiner son dernier envoi d'architecte sur une méchante petite table, dépourvu de ce qui pouvait l'aider à mener à bien sa besogne. Les dessins qu'il faisait à l'Académie étaient d'une précision inouïe et, sous ce rapport, d'une perfection à laquelle personne encore n'avait su atteindre. On vantait alors, à Rome et à Paris, les dessins de Duban, qui sont en effet des morceaux exquis, recherchés, dans lesquels la vérité se mêle à un certain charme irrésistible, provenant de l'émotion que l'artiste a éprouvée devant les monuments antiques, et qui se trahit dans l'exécution de ses aquarelles et dans leur coloris. Lefuel, moins ému, du moins en apparence, se contente de la vérité parfaite; une fois qu'il est parvenu à une exactitude rigoureuse et, à vrai dire, incomparable, il se repose sur son modèle du soin de nous transmettre les impressions que nous devons ressentir. Il trouve ainsi la poésie, sans la chercher peut-être, dans la seule fidélité d'une imitation qu'il pousse jusqu'au miracle de l'identité.

" J'ai passé, il y a deux jours, de bien bonnes heures à regarder les dessins que Lefuel fit à Rome, à Naples, en Sicile, en Toscane. Ils sont réunis dans un album que lui n'avait jamais consenti à me montrer, estimant que le dessin est, pour un architecte, un moyen et non pas un but. J'ai feuilleté, j'ai vu et revu cet album avec d'autant plus d'attention et un intérêt d'autant plus vif que les dessins de nos pensionnaires, exécutés à l'Académie, sont toujours ce qu'ils ont fait de mieux. C'est là qu'ils ont mis toute leur jeunesse, toute leur volonté, toute leur âme. Ce sont, comme ils disent, leurs morceaux de bravoure.

" À Rome, Lefuel dessine le monument de Sabelli, tombeau du moyen âge dans la basilique de l'Aracœli, et il en exprime le caractère, il en dit les finesses, il en formule scrupuleusement les plis. À Naples, il étudie d'abord les formes et la décoration des vases antiques, le canthare, le lécythus, le cyathus, l'amphore, l'œnochoë, le cylix, ensuite les bronzes trouvés à Herculanum et à Pompéi : lampes, candélabres, trépieds, cinéraires, boîtes à parfums, vases à libation, strigiles, conques, instruments de musique, et il fait sentir la délicatesse de chaque profil, la dureté du métal et sa résonance. S'il peint des masques de théâtre, il en reproduit l'expression à outrance avec une telle intensité, avec un tel accent dans la violence de leur grimace tragique, qu'un peintre de profession ne saurait aller plus loin, ni peut-être même aussi loin. Le moindre fragment d'architecture polychrome que Lefuel a rencontré dans les ruines d'Agrigente, un chéneau, un larmier, un bout de frise, un chapiteau dorique, il les copie avec un soin religieux.

" D'un coup de pinceau leste et léger, mais ferme, il fait serpenter une doucine, se hérisser une palmette, tourner l'échine sous l'abaque saillante. Ses tons de couleur sont attaqués avec franchise, avec crudité, quand il faut, mais sans être exaltés comme se plaisent à les faire nos jeunes architectes, et lorsqu'une antéfixe a pâli par places, avec le temps, il la décolore au plus juste, au plus vrai. À San Miniato, Lefuel dessine les ambons, et il en prononce le fier caractère ; il copie les peintures de Taddeo Gaddi dans les retombées d'une voute d'arête, et il les reproduit *ne varietur.*

" À Corneto, il lave en couleurs des tombeaux étrusques tout remplis de ces figures que les vases antiques nous ont appris à admirer : jeunes cavaliers d'une élégance farouche, danseuves au sourire figé, chevaux de main que l'on conduit au stade et qui sont dessinés à forte encolure, mais sveltes, haut montés, avec des boulets minces, tels que la mémoire se les représente, quand ils passent, non pas dans l'arène, mais dans l'esprit. Avec une patience inimaginable et qui pourtant ne trahit aucun effort, Lefuel poursuit les colorations en détail des mosaïques les plus compliquées, sans jamais être fastidieux même quand il applique une touche d'ocre, de cinabre ou d'or pur sur les cases d'un pavement en échiquier.

" Si l'on me demande ce qui caractérise les dessins de Lefuel, je réponds qu'ils ne portent pas l'empreinte

d'un sentiment personnel, qu'on n'y trouve pas, pour mieux dire, cette pointe d'exagération, dans un sens ou dans l'autre, qui laisse deviner l'émotion que l'artiste a ressentie devant tel ou tel objet. Lorsqu'on voit, par exemple, un dessin de Duban—je continue cette comparaison uniquement pour me faire mieux comprendre—on sent que son cœur a battu, qu'il a choisi sa lumière, qu'il a invoqué la poésie du clair et de l'obscur : les dessins de Lefuel ne procèdent que de l'esprit. Ils sont les produits d'une intelligence prodigieusement lucide, d'une vision nette, perçante et sûre, d'une volonté indomptable. Il ne s'y manifeste aucun aveu d'enthousiasme ou d'admiration, aucune intention de poésie.

"Telle ruine auguste l'a touché peut-être ; mais son crayon et ses couleurs ne nous en disent rien. Si la lumière joue un rôle dans son dessin, c'est la lumière convenue, à quarante cinq degrés, celle dont se sert le professeur de géométrie descriptive pour éclairer la théorie des ombres." . . . . .

"Construire un manège et des écuries comme il l'a fait avec tant de magnificence et de comfort dans une des cours méridionales du palais ; décorer des salons officiels et des appartements privés, les uns avec pompe, les autres avec grâce ; s'inspirer tour à tour de Berain, de Lepautre, de Salembier, de Lalonde, de Gouthière, et rester libre dans ses imitations ; inventer avec une fécondité intarissable des dessus de porte, des couronnements de glace, des panneaux d'arabesques, des médaillons enrubannés, des rosaces, des coquilles changées en nids d'oiseaux, des cartouches à orner les angles d'une voussure, enchevêtrer des feuilles d'acanthe et des branches de laurier avec des rinceaux d'une suprême élégance ; ciseler du bout de son crayon des serrures aux chiffres sommés, des verrous plus délicats que celui de Fragonard, tempérer l'éclat des colorations et des ors par des camaïeux tendres, fouiller des ornements d'un ton argenté pour une cheminée de marbre noir, transformer en objet d'art une plaque de foyer en fonte grise . . ., tout cela n'était qu'un jeu pour ce travailleur infatigable que les profondes études de sa jeunesse dispensaient maintenant de la patience. Là où il déployait surtout la souplesse de son talent, c'était dans ses dessins d'escalier qu'il variait selon les circonstances, et qui sont presque tous remarquables et trouvés, celui du manège par exemple, décoré par Barye et Frémiet, et celui du pavillon de Flore, dont le plafond, peint par Cabanel, est un des excellents morceaux de l'école française.

"Malheureusement pour Lefuel, ses meilleurs ouvrages sont inconnus au public : l'hôtel Fould, rue du Faubourg-Saint-Honoré, qui est jalousement caché aux regards du passant par un mur très haut, percé de deux portes ; la cheminée monumentale exécutée sur les dessins de Lefuel, à Florence, dans le palais ducal, par M. Ottin ; l'hôtel d'un collectionneur bien connu, M. Riggs (rue Murillo, à Paris), petit chef-d'œuvre bâti sur un terrain affreusement ingrat. Dans un boyau de huit mètres de façade sur trente-cinq de profondeur, Lefuel a trouvé moyen d'aménager une demeure qui paraît spacieuse, avec un grand atelier, un *patio*, c'est-à-dire une cour intérieure, éclairée par un toit de verre et remplie de plantes exotiques, une galerie pouvant contenir la plus belle collection d'armures qu'un simple amateur ait jamais réunie, un appartement d'artiste et un sous-sol à l'anglaise.

"La vie de Lefuel ne fut pas embarrassée par les principes de l'architecture, par ce que nous appelons l'esthétique, nous autres pédants. Il eût été moins fier d'obtenir l'approbation des raffinés, que d'avoir préservé le Louvre de tout incendie par une conduite d'eau que tout le monde ignore. Pour lui, son art était rivé au relatif, et par cette conviction il se rattachait au dix-huitième siècle. Il avait d'ailleurs l'esprit de ce temps-là ; il en maniait, il en écrivait la langue, au besoin, comme un lettré qu'il était. Sa parole nette, incisive, colorée parfois, allait droit à la pensée et mettait en relief une vérité qu'on aurait pu croire, au premier abord, paradoxale. Il était convaincu et persuasif. Ceux qui ont le culte du sentiment dans l'art, ceux qui regardent les Grecs d'Athènes et les Grecs de Bysance comme les premiers architectes du monde parce que, après avoir bâti le Parthénon et les Propylées, ils ont élevé l'incomparable coupole de Sainte-Sophie, ceux-là peuvent regretter que Lefuel n'ait pas donné suite aux explorations de son maître dans les pays antiques. En étudiant sur place les monuments grecs, il aurait vu, il aurait senti que la Renaissance n'avait fait *renaître* qu'une architecture grandement altérée par les Romains, et cela faute d'avoir connu les exemplaires de l'art pur."

The Hôtel Fould, referred-to in the above extracts as the work of Lefuel, which was No. 129, Rue du Faubourg-Saint-Honoré, no longer exists. An hôtel in the Rue de Monceau for the Count de Nieuwerkerke is the work of Lefuel, who completed the Hôtel Paiva, begun by M. Manguin, in the Champs-Élysées; he also erected an hôtel at Abbeville for the Count d'Emouville. Two monuments in the Cemetery of Père-Lachaise to the memory of the musicians, Auber and Bazin, members of the Institut de France, were designed by him, and from 1869 to 1876 he was employed in the design of an important château in Upper Silesia, described as a residence of the most sumptuous character.

Lefuel was elected an Hon. & Corr. Member in 1857, and he was one of those who attended the funeral of the younger Cockerell at Paris in 1878. At the Great Exhibition held there in that year he was chairman of the jury in the section of architecture, and President of the International Congress of Architects, which met at the same period. He was President of the Cercle des Maçons, in Paris, a technical society of recent formation. He was a member of the Institut de France, and a *Commandeur* of the Légion d'Honneur. He had filled the presidentship of the Société Centrale des Architectes, and at the time of his death was Vice-President and Inspector-General of the Conseil des Bâtiments Civils. Referring to his work in the latter capacity M. Normand, who shared in it, says "que sa grande connaissance des affaires lui permettait de présider avec un tact qui faisait écouter sa parole; ses remarquables rapports mettent en lumière sa haute intelligence, sa rare droiture, son esprit judicieux."

FRANÇOIS AUGUSTE FERDINAND MARIETTE,

Hon. & Corr. Member (Cairo).

MARIETTE-PASHA was born at Boulogne-sur-mer on the 11th February, 1821. His father held the appointment (1815-50) of Town Clerk of Boulogne; his grandfather, who died in 1806, was an officer of the French Navy, and is said to have been taken prisoner by the English during the Seven Years War. His great-grandfather was the Advocate Mariette, mentioned in the *Histoire des Protestants Français,* as one of the four jurisconsults who voted against the judicial murder of Calas, the Calvinist, and to whom reference is several times made by Voltaire in his *Histoire abrégée de la mort de Jean Calas,* and in his *Lettre à M. d'Alembert sur les Calas et les Sirven* (1st March, 1765). Another Mariette, residing in Boulogne in 1749, was the author of "quelques pièces de vers assez bien tournés," to use the words of M. Ernest Deseille, in a Notice* of Mariette's early life at Boulogne anterior to 1850, when he left for Egypt. From the same publication it appears that Mariette—driven from home by domestic discomfort consequent on his father's second marriage—came over when only eighteen to this country at the instigation of an English friend, and for a while taught French and drawing in Staffordshire. A few months later he seems to have had some idea of making designs for the Coventry manufacturers: an idea which, fortunately for the world, was never carried-out, for he returned to Boulogne (though not to his father's house) to resume his literary and scientific studies. In 1841 he took his bachelor's degree with honours at the University of Douai; and for some time he was a constant contributor to the local press. To the duties of a chair in his old college he united those of secretary to the Société de l'Agriculture et des Sciences, and also to the Société des Amis des Arts, as well as of editor of a Boulogne newspaper. His essays on the old corsairs, his criticisms on picture galleries and exhibitions, his tales of fiction, his articles on passing events, would fill several volumes, and they testify to the versatility of Mariette's talents. Moreover, in company with his brother, Alphonse, he made a careful survey of the coast for a considerable distance N.E. and S.W. of Boulogne, with a view of finding the most probable spot at which Julius Cæsar embarked for Britain, and he published an elaborate essay on the

* See *Les Débuts de Mariette-Pacha*, by Ernest Deseille, Boulogne-sur-mer, 1881, pamph. 8vo.

different names of Boulogne during the Roman period: *Portus Itius, Gesoriacum, Bononia.** But a wider field of archæological research was marked-out for him. In 1842, on the death of his cousin, Nestor L'Hôte, the companion of Champollion during the famous exploration of Egypt in 1827-29, Mariette was commissioned to put his relative's papers and drawings in order. This circumstance placed him in possession of valuable and authentic *data,* and led to his first attempts to decipher the mysterious language of the ancient Egyptians. Having partly achieved this with the limited assistance of a provincial museum, he applied to M. de Salvandy, the then Minister of Public Instruction, to be sent on a mission to Egypt, a request which was not granted, on the plea that "another gentleman had just been sent to Cairo" for that very purpose. Nothing daunted, Mariette devoted himself all the more vigorously to his studies, the first result of which was a pamphlet entitled *Sur le côté gauche de la Salle des Ancêtres de Thoutmès III.* This pamphlet addressed to M. Charles Lenormant, Curator of the Bibliothèque Nationale and Professor of Archæology at the Collège de France, elicited from the veteran scholar flattering encouragement for the young egyptologist. In a letter dated from Paris, 15th April, 1849, Lenormant wrote of Mariette and his *mémoire* thus:—

"Je n'avais pas l'honneur de le connaître, lorsqu'il m'a apporté un manuscrit relatif à plusieurs des questions les plus difficiles que soulève l'archéologie égyptienne. J'ai lu ce manuscrit avec la défiance qu'on a toujours contre les essais des personnes qu'on suppose n'avoir pu puiser l'instruction scientifique à ses véritables sources, et j'ai été agréablement surpris dans le sens contraire. C'est la première fois, en effet, que j'ai vu un homme, livré à des études isolées, marcher dans la bonne voie aussi vîte et aussi bien. Ce début est du plus heureux augure pour l'avenir de M. Mariette."

A year later Mariette was appointed a supernumerary assistant keeper at the Louvre, and after the lapse of a few months, he wrote a Paper entitled *Bibliographie copte,* which obtained for him his long wished-for mission to Egypt. He was sent to follow in the track of Lord Prudhoe, afterwards Duke of Northumberland, and obtain for France some of the Coptic MSS. known to be preserved in certain Egyptian monasteries. He arrived there on the 12th October, 1850, and thenceforward the life of Mariette is a part of cosmopolitan history. The description given of him by his brother, in a letter to *Le XIX^e^ Siècle,* conducted by M. Edmond About, is interesting and worth recording. "Tout le monde sait," wrote M. Alphonse Mariette,† "qu'ayant passé quelques semaines aux environs des pyramides et dans la plaine de Saqqarah, en attendant son compatriote Linant-Bey qui avait obligeamment offert de l'accompagner aux monastères, Mariette se sentit irrésistiblement arrêté dans cette plaine, au milieu de ces sables mystérieux. Il était venu là pour quinze jours. Il y resta quatre ans. Je n'ai ni le temps ni le courage d'entrer aujourd'hui dans les détails de ce séjour de quatre ans à Saqqarah. C'est une véritable épopée qui attend encore son historien,—une épopée digne d'une plume inspirée, d'une plume comme celle que vous maniez, monsieur, avec un talent unique. Vous

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* See *Lettre à M. Bouillet .... sur l'article "Boulogne" de son Dict. Universel d'Histoire et de Géographie.* Boulogne, 1847. Pamph. 8vo.

† The Professor of French Literature at King's College (Lond.), who, in a letter written to Miss Amelia B. Edwards and published in *The Academy* (5th Feb., 1881), describes his brother as "a striking-looking man, broad-chested, and about six feet in height." M. Arthur Rhoné (see his work entitled *L'Égypte à petites journées,* p. 56) seems to have been awe-struck when first introduced by M. de Lesseps to Mariette, whom he describes as "très-effrayant, le bey, avec sa haute taille, son tarbouch rouge très-enfoncé, sa figure sévère et accentuée, son parler bref, et les redoutables lunettes noires bombées, qui cachent complètement ses yeux depuis l'ophthalmie terrible qui les frappa lors des premières fouilles du désert de Saqqarah. Mais bientôt, se voyant, malgré cela, environné d'amis et d'intelligences sympathiques, il s'anime et devient étincelant de verve et d'esprit."

savez comme moi tout ce que les fouilles de Saqqarah ont coûté de labeur, tout ce qu'elles ont provoqué de luttes incessantes, de tracas de toute espèce et de dangers physiques, et aussi tout ce qu'elles ont produit d'incomparables trésors." *

Mariette's discovery of the Serapeum has not lost its early tinge of romance, either by the numerous descriptions of successive travellers and critics, or by the sober language of the discoverer himself, as year after year he communicated to the world his budget of facts. He was commissioned by the French Government to visit Egypt, for a certain purpose, at the public cost, and from the hour almost of his arrival in Egypt his attention was turned to another and, as it has resulted, a more important object than the mission with which he was intrusted. He had seen † in several gardens in Alexandria a number of antique sphinxes, of uniform type and dimensions, and he was told that they came from Sakkarah. At Cairo he found other examples all similar, and from the same place, and he always remarked that they bore on their socles or on their sides marks in Greek characters, like the roughly-cut names of travellers or pilgrims, and he had always read on them the names of Osiris, Apis and Serapis. He remembered also Strabo's mention of a temple of Serapis at Memphis, where the sands were blown by the wind in such masses that sphinxes were interred some half-way, others up to the head, by which the historian conjectured that the road to the temple was not unattended with danger, if travellers were surprized by a storm of wind. Mariette concluded that the sphinxes he saw were some of those which had been seen by Strabo, and a few days afterwards he was at Sakkarah, pencil in hand.‡

A description of the excavations at Gizeh and Sakkarah was given to the Institute by Professor Donaldson, at a Meeting held in February, 1861, soon after his return from a

* M. About, in *Le Fellah*, has the following description :—"Mariette-Bey nous reçut à bras ouverts ; c'est un des hommes les plus complets qui soient au monde : savant comme un bénédictin, courageux comme un zouave, patient comme un graveur en taille-douce, naïf et bon comme un enfant, quoiqu'il s'emporte à tout propos, malheureux comme on ne l'est guère, et gai comme on ne l'est plus ; brûlé à petit feu par le climat du tropique, et tué plus cruellement encore dans les personnes qui lui sont chères ; salarié petitement, presque pauvre dans un rang qui oblige ; mal vu des fonctionnaires et du peuple, qui ne comprennent pas ce qu'il fait et considèrent la science comme une superfluité d'Europe ; cramponné malgré tout à cette terre mystérieuse qu'il sonde depuis bientôt vingt ans pour lui arracher tous ses secrets ; honnête et délicat à s'en rendre ridicule, conservateur têtu de l'admirable musée qu'il a fait et qu'on ne visite guère ; éditeur de publications ruineuses que la postérité payera peut-être au poids de l'or, mais qui sollicitent en vain les encouragements des ministères, il honore la France, l'Égypte, l'humanité, et, quand il sera mort de désespoir, on lui élèvera peut-être une statue."

† See M. Arthur Rhoné's *L'Égypte à petites journées*, Paris, 1877, pp. 213, *et seq.*

‡ In a private letter, written on the 21st of May, 1856 (quoted in *L'Égypte à petites journées*), Mariette described his first impressions thus :—"Frappé du travail uniforme qui les distingue, frappé également des inscriptions grecques dont ils sont couverts, et apprenant en outre qu'ils provenaient tous de la plaine de Saqqarah, j'avais, dès mon arrivée au Kaire et avant d'avoir vu encore une seule fois Memphis, annoncé à M. Fresnel que les sphinx provenaient du Sérapéum. C'est un fait que M. Fresnel se plaisait à raconter et qu'il a communiqué entre autres à M. Oppert sur les ruines de Babylone. Voilà comment le passage de Strabon a produit la découverte du Sérapéum." Again, in Mariette's *Choix de monuments du Sérapéum* (p. 7), he says :—"Cet endroit sablonneux où Strabon suivait l'allée des sphinx qui mène au Sérapéum était évidemment celui où se retrouvaient les sphinx de Saqqarah. Là, par conséquent, était le Sérapéum ; et quand, quelques jours plus tard, parcourant cette même plaine sablonneuse le crayon en main, il m'arriva de rencontrer un sphinx encore debout sur son piédestal, je n'eus plus dès lors aucun doute. Le Sérapéum était découvert." Mariette appears also to have ascertained how and when the sphinxes, which he saw on his arrival, were brought from Sakkarah. In 1832, in an excavation casually made by Dr. Marucchi, two sphinxes

visit to the Serapeum.* The recent discoveries† at Sakkarah were also referred-to by the Professor towards the close of the Session 1880-81. Previous to this, in April, 1881, a notice appeared in *The Times* of a communication made to the Institut Égyptien by Brugsch-Pasha the German egyptologist, from which the following is an extract (translated):—" Fifteen days before his death Mariette-Pasha, the President of the Institut, summoned me to his bedside, and begged me to render to him and to science a service of which he could not calculate the importance. Last year, after he had left for France, he had heard that his Arab labourers had opened one of the Sakkarah pyramids. They had opened the north door and cleared the passage which led to the funereal chamber in the interior. Along the whole passage, 36 mètres in length, the walls were covered with hieroglyphics, which constantly reproduced the names 'Merira' and 'Pepi' encircled by the Royal elliptic. Mariette, to whom were sent impressions of these hieroglyphics, believed they only applied to some high functionary of State, as neither of the names was preceded with the usual Royal titles of the Pharaohs. At the same time Mariette informed me that the Arabs had found the entrance of another pyramid near the first, with the passage and funereal chamber similarly adorned, with numerous inscriptions. 'Go, to-morrow,' he said, 'and study and report on these two pyramids.' I went next day early, and late in the evening presented my poor friend the following report. His eyes glistened with joy as I read it:—

"'The two funereal monuments are not mere *mastaba* (ordinary rock tombs), but true pyramids. They inclose, the one, the tomb of King Pepi with his official title, Merira; the other, the tomb of King Horemsaf, the son of Pepi, of the sixth dynasty, according to Manetho. The granite sarcophagi, which once held the mummies of these two Kings, have been found in their original places. The hieroglyphics with which they are covered prove that the names of Pepi and Horemsaf belong to Kings, and not to mere Court functionaries. The mummy of the son of King Pepi, well preserved, though robbed of its ornaments and its linen, has been found in its pyramid. The two pyramids are the earliest examples of Royal tombs of the period of the old Empire adorned with hieroglyphics, which not only give the names of the Kings who are buried there, but which also set forth for the first time a long series of religious texts, like the Book of the Dead of subsequent epochs. They also mention the star Sothis (Sirius), the planet Venus, and thus prove a certain astronomical knowledge as long ago as the 6th dynasty. The passages and the funereal chambers, with the sarcophagi, the mummies, and the objects originally placed there, have been either very roughly handled or taken away altogether. The *stela* of Una in the Boulak Museum gives a confirmation of the contents of these two pyramids. Una was an official of King Pepi and his son, and executed many important works for them, of which he boasts on his *stela*. The numerous inscriptions cut in the stone and painted green are of the highest importance. They give an exact idea of the theological notions which obtained at this remote period, and at the same time throw new light on the dictionary, grammar and syntax, and generally on the language and writing of the most ancient known date of Pharaonic Egypt.'

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were discovered and taken out of the sand, but they were left on the plain of Abousyr, where any traveller could see them. Some years afterwards, continuing the excavation of Dr. Marucchi, an inhabitant of Cairo discovered about thirty more sphinxes. Of these, twelve were placed in the gardens, at Alexandria, of M. Zizinia, the Belgian Consul; two were sold to Clot-bey, two to Varin-bey, two to Linant-bey, and the twelve others were sold to an Englishman, who, about 1842, took them to Calcutta. The site of Memphis, according to Mariette, was not known for certain until after the French expedition to Egypt at the close of the last century, and most of the authorities, French, German and English, have been at fault respecting the Serapeum. M. Jomard, in his *Description de l'Égypte*, said, as regards the position of the Serapeum, "Pour le découvrir, il faudrait opérer de grandes fouilles entre Saqqarah et la pyramide à degrés qui est au nord," and the alley of sphinxes passes at the foot of that pyramid. Sir Gardner Wilkinson accepted the assertion of M. Jomard. Colonel Vyse and his assistants made excavations for the Serapeum between Abouzyr and Sakkarah, and Professor Lepsius at Dashour.

* See the TRANSACTIONS, 1860-61, page 190.

† See *The Builder*, vol. xl. p. 591, and vol. xli. pp. 202, 226.

"After he had heard to the end Mariette took my hand and thanked me earnestly. 'It is worth the Serapeum,' said he, 'but shall I ever see these two pyramids?' I returned again in a day or two, but he could not speak, and on the 18th of January he passed away."

A catalogue of Mariette's published works, drawn-up under his personal direction in May, 1879, is to be found in the *Gazette des Beaux Arts* (Sept. 1881), where it forms an appendix to an admirable narrative of his career, contributed by M. Arthur Rhoné. This catalogue, which serves to give an idea of Mariette's labours as a discoverer and a writer, is here printed almost in its entirety:—

1847. Musée de Boulogne-sur-Mer. Catalogue analytique des objets composant la Galerie égyptienne, *Boulogne, Birlé*, in-12, 19 p.

Lettre à M. Bouillet sur l'article *Boulogne* de son Dict. univ. d'hist. et de géographie. Dissertation historique et archéologique sur les différents noms de Boulogne dans l'antiquité, etc. *Paris, Leleux*, in-8°, 71 p.

1849. Sur le côté gauche de la *Salle des Ancêtres* de Thoutmès III et en particulier sur les deux dernières lignes de cette partie du monument. In-4°, 70 feuillets.

*** MS. addressed to M. Charles Lenormant, and mentioned on page 43 *ante*.

Bibliographie copte, in-4°.

*** MS. also referred-to on page 43 *ante*.

1850. Note sur un fragment du Papyrus royal de Turin et la VI[e] dynastie de Manéthon, *Revue archéologique*, 1[re] série, tome VI, pp. 305-315.

1854. Note sur la découverte et sur les fouilles du Sérapéum de Memphis.

*** Read by the author to the Académie des Inscriptions, on the 8th and 15th December, 1854.

Note sur les fouilles exécutées par M. Mariette autour du grand Sphinx de Gizeh. Lettres de Mariette citées par M. de Rougé dans *l'Athénæum français*.—3[e] année, 28 janvier, 1854. In-4°, 2 p.

1855. Renseignements sur les soixante-quatre Apis trouvés dans les souterrains du Sérapéum de Memphis.—*Bulletin de l'Athénæum français*, 1855, pp. 45, 53, 66, 85, 93—et 1856, pp. 58, 74.

1856. Fragment du sarcophage phénicien conservé au Musée de Berlin. *Bulletin de l'Athénæum*, 1856, p. 49.

Mémoire sur la Mère d'Apis.—*Paris, Gide et Baudry*, in-4°, 62 p.

Choix de monuments et de dessins découverts ou exécutés pendant les déblayements du Sérapéum de Memphis.—*Paris, Gide et Baudry*, in 4° de 12 p. texte, avec 10 planches gravées sur acier ou lithographiées.

1857. Le Sérapéum de Memphis découvert et décrit, etc.—*Paris, Gide.* In fol. de 30 p. texte, et 36 pl. en chromolithogr. et photolithogr. Poitevin.

*** Publication interrupted by the failure of the Publisher.

1858. Nouvelles découvertes en Égypte. Lettre de M. Mariette à M. de Rougé.—*Comptes rendus de l'Acad. des Inscript.*, t. II, 1859.

1859. Communications sur le Trésor de la reine Ptah-Hotep récemment découvert, sur le *Blé de momie*, etc. *Bulletin de l'Institut égyptien, Alexandrie*, 1859, p. 30-36, et 1861, p. 84.

Essai sur l'état actuel et les résultats jusqu'à ce jour des travaux entrepris pour la conservation des antiquités égypt. en Égypte. *Comptes rendus de l'Acad.*, t. III, 1862, p. 153, et t. V, p. 161.

1860. Lettre à M. le vicomte de Rougé sur les résultats des fouilles entreprises par ordre du vice-roi d'Égypte. —*Rev. archéolog.*, juillet 1860 18 p.

Extrait d'une lettre de M. Mariette à M. Jomard (sur les fouilles de Thèbes, d'Abydos, de Saqqarah, sur le musée de Boulaq, etc.)—*Rev. archéolog.*, août 1860, 2 p.

1861. Lettre à M. le Vicomte de Rougé sur les fouilles de Tanis.—*Rev. archéolog.* févr. 1861, 15 p. Av. 2 pl. lith. d'un Sphinx Hyksos.

Extrait d'une lettre à M. Alfred Maury (sur les monum. des Hyksos trouvés à Tanis.)—*Rev. archéolog.*, avril 1861, 3 p.

1862. Deuxième lettre à M. le vicomte de Rougé sur les fouilles de Tanis.—*Rev. archéolog.*, mai 1862, 8 p. av. 2 pl. lith. des rois porteurs d'offrandes.

1863. Lettre à M. le vicomte de Rougé, sur une stèle trouvée à Gebel-Barkâl.—*Rev. archéolog.*, juin 1863, 9 p.

1864. La table de Saqqarah.—*Rev. archéolog.*, septembre 1864, 20 p.

1864. Aperçu de l'Histoire d'Égypte, etc., jusqu'à la conquête arabe.
Première édition.—*Alexandrie, Mourès*, 1864, in-8°
— sous-édition, imprimée pour l'Exposition universelle de 1867. *Paris, Dentu*, 1867, in-8°. *
Deuxième édition.—*Paris, Vieweg*, 1870, 1 vol. in-12.
Troisième édition.—*Alexandrie, Mourès et Cie*, 1872, in-12.
Quatrième édition.—*Le Caire, Mourès*, 1874, in-8°.
Notice des principaux monuments exposés dans les galeries provisoires du Musée d'antiquités égyptiennes de S. A. le vice-roi, à Boulaq (Catalogue du musée). Première édition.—*Alexandrie, Mourès*, 1864, in-8°.
Deuxième édition.—*Alexandrie, Mourès*, 1868, in-8°.
Troisième édition.—*Paris, Vieweg*, 1869, in-8°.
Quatrième édition.—*Paris, Vieweg*, 1872, in-8°.
Cinquième édition.—entièrement refondue. *Le Caire, Mourès*, 1874, in-8°.
Sixième édition.—*Le Caire, Mourès*, 1876, in-8°.
Communication sur les populations du lac Menzaleh et les races qui peuplent l'Égypte. *Bulletin de l'Institut égyptien*, 1864, p. 103.

1865. La stèle de l'an 400 (découverte a Tanis).—*Rev. archéolog.* mars 1865, 19 p.
Fragments de deux lettres addressés d'Égypte à MM. Egger et de Rougé.—*Comptes rendus de l'Acad. des inscrip.*, 1865, p. 74-75.
Quatre pages des archives officielles de l'Éthiopie.—*Rev. archéolog.* septembre 1865, 17 p.
*** Description of five *stèles* found at Gebel-Barkâl.

1866. La nouvelle Table d'Abydos.—*Rev. archéolog.*, février 1866, 26 p.
Lettre à M. Brunet de Presle sur la stèle bilingue de Chalouf (Isthme de Suez).—*Comptes rendus*, 1866, p. 285-90.

1867. Note sur l'utilité des allitérations pour le déchiffrement des hiéroglyphes.—*Rev. archéolog.*, avril 1867, 6 p.
Exposition universelle de 1867. Description du Parc égyptien, etc., *Paris, Dentu*, in-18, 102 p.
Fouilles exécutées en Égypte, en Nubie et au Soudan, d'après les ordres du Vice-roi, &c. (Gebel-Barkâl, Abydos).—*Paris, Frank*, 1867, 2 vol. in-fol., planches et texte.
*** This work was stopped and its contents were divided between the *Abydos* and the *Monuments divers, &c.*

1869. Sur les tombes de l'Ancien Empire que l'on trouve à Saqqarah.—*Rev. archéolog.*, janvier 1869, 25 p. et 3 pl. gravées.
Description du temple de Dendérah.—*Mém. de l'Acad. des inscript. Savants étrangers*, t. VIII, 2e part.
*** Read at the Meeting held 27 August, 1869.
Une visite au Musée de Boulaq, ou description des principaux monuments conservés, etc., etc.—Texte arabe.
*** An edition in French, published simultaneously with that in Arabic, is now out of print.
Itinéraire des invités aux fêtes d'inauguration du Canal de Suez, etc., etc. *Le Caire*, 1869 ; 1 vol. pet. in-8°, avec 2 cartes.—Autre édition, *Paris, Frank*, 1869, in-12.
Abydos.—Description des fouilles exécutées sur l'emplacement de cette ville.
Tome Ier.—Ville antique. Temple de Séti.—*Paris, Vieweg*, 1869, in-fol., 86 p., texte et tableaux ; 53 pl.
Tome II.—Temples d'Osiris, de Ramsès II, Petit temple de l'ouest et nécropole.—*Paris, Maisonneuve*, 1879, in-fol.
Tome III.—Catalogue général des monuments d'Abydos découverts pendant les fouilles de cette ville, *Paris*, imprimé par autorisation du gouvernement a l'*Imprimerie nationale*, 1880, in-4°, 596 p.

1870. Scenario de l'opéra d'*Aïda*, composé à la demande du khédive Ismaïl pour l'inauguration de la nouvelle salle du Caire.
*** Ten copies, printed by Mourès at Alexandria. Afterwards arranged in prose by Cam. du Locles, translated into Italian verse, and re-translated for the Opera in Paris. (See the *Journal des Débats*, 26th March, 1880.)

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* The only work (a pamphlet) of Mariette's in the Library of the Institute. He is described on the title-page as Conservateur adjoint honoraire des Musées Impériaux de France, and also as Directeur-Général du Service de Conservation des Antiquités de l'Égypte.

1870. Compte rendu des principales fouilles en cours d'exécution. *Bulletin de l'Institut égyptien*, mai 1870, p. 51-81.

Dendérah. Description générale du grand temple de cette ville.—*Paris, Vieweg*, 1870-1875, 5 vol. planches in-fol. et 1 vol. texte in-4°.

Remarques sur l'âge de pierre en Égypte. Mémoire lu à l'Académie, le 4 novembre 1870.

1871. Les papyrus égyptiens du Musée de Boulaq, publiés en fac-simile.—*Paris, Vieweg*, 1871-78 ; 3 vol. in-fol. Planches sans texte.

Album du Musée de Boulaq, comprenant 40 pl. photographiées par Délié et Béchard, avec un texte explicatif par Aug. Mariette.—*Le Caire, Mourès*, in-fol.

1872. Monuments divers recueillis en Égypte et en Nubie.—*Paris, Vieweg*, 1881. In-fol. de 114 pl. sans texte.

Itinéraire de la haute Égypte, comprenant une description des monuments antiques des rives du Nil, etc. *Alexandrie, Mourès et Cie*, in-12 avec plan.—Nouvelle édit.—*Paris, Maisonneuve*, 1880, in-18, format. diamant.

*** An English edition of this work, published at London, Cairo and Alexandria, translated by M. Alphonse Mariette, is entitled *The Monuments of Upper Egypt*, &c. *London*, 1877, 8°.

1873. Observations insérées à la suite d'un article intitulé : " Études sur une inscription grecque découvert e dans les ruines du temple de Ptah à Memphis," par E. Miller.—*Melanges d'archéolog. égypt. et assyr.*, t. Ier, 1873, p. 51.

Note sur les Baschmourites et les Biamites (populations du lac Menzaleh).—*Mélanges d'archéolog. égypt. et assyr.* t. Ier, 1873, p. 93.

1874. Exposé des travaux exécutés à Karnak dans l'hiver de 1873-1874, sur l'ordre du khédive, et d'une découverte importante qu'ils ont amenée.—*Bulletin de l'Institut égyptien*, 1874-1875.

Mémoire sur les listes géographiques du pylône de Thoutmès III, à Karnak.—*Comptes rendus*, 1875, p. 243-260, et 1876, p. 21.

1875. Liste géographique des pylônes de Karnak, comprenant la Palestine, l'Éthiopie, le pays des Somâl.—*Le Caire*, 1875, et *Leipzig, Heinrichs*. Atlas de 3 cartes in-fol. et 1 broch. in-4° de 66 p.

Karnak.—Étude topographique et archéologique avec un Appendice comprenant les principaux textes hiéroglyphiques découverts ou recueillis pendant les fouilles exécutées à Karnak par Aug. Mariette-bey. —*Le Caire*, 1875, et *Leipzig, Heinrichs*, atlas in-fol. de 56 plans et planches ; 1 vol. in-4° de texte, 88 p.

Plan du grand temple de Karnak.—1 planche in-fol. accompagné de 14 p. de texte, dans une couverture toile, pet in-8°.

*** Intended for explorers. There is also a similar edition in English.

1877. Deïr-el-Bahari.—(Temple funéraire de la reine Hatasou, à Thèbes), Documents topographiques, historiques et ethnographiques recueillis dans ce temple pendant les fouilles exécutées par Aug. Mariette-bey.—*Leipzig, Heinrichs*, 1 vol. pl. in fol. et 1 broch. texte de 40 p. in 4°.

1878. Voyage de la haute Égypte. Explication de Vues photographiques d'après les monuments antiques compris entre le Caire et la 1re cataracte. *Le Caire, Mourès, et Paris, Goupil et Cie*, 1878-80, 2 vol. in-fol. de 83 planches en photogravures, avec texte par Mariette-bey.

*** Mariette himself selected the points to be photographed and directed the photographers.

L'Égypte à l'Exposition universelle de 1878, album de 12 vues photographiques exécutées par Braun, sous la direction de Mariette-bey.

Exposition universelle de Paris, 1878. La galerie de l'Égypte ancienne à l'Exposition rétrospective du Trocadéro. Description sommaire.—*Paris*, 1878, in-8° de 123 p.

1879. Lettre à M. E. Desjardins sur deux stèles d'Abydos et une stèle de Saqqarah, nouvellement découvertes ; Boulaq, 2 mai 1879.—*Comptes rendus*, 1880, p. 121-131.

Mémoire sur les nouvelles fouilles à opérer en Égypte.

*** Read by Mariette at the French Academy on the 10th October, 1879.

Extrait d'un mémoire intitulé : Questions relatives aux nouvelles fouilles à faire en Égypte. Lu par M. E. Desjardins dans la séance publique de l'Acad. des Inscript., le 21 nov. 1879.—*Paris, Didot*, in-4°, 54 p.

The death of Mariette called forth merited eulogies from those of his countrymen who, like him, had served France in remote and barely known, sometimes unexplored, parts of the world; and none more eloquent than the one which appeared in the *Revue des deux Mondes*,

from the pen of the celebrated archæologist and traveller, the Marquis de Vogüé, *Hon. & Corr. Member*, whose personal reminiscences of Mariette are told in the following extracts :—

"Une bien triste nouvelle nous arrive d'Égypte : Auguste Mariette est mort. Jadis le malheur cheminait d'un pas lent, atteignant tour à tour les cœurs qu'il visait ; le progrès l'a fait,—si c'est là du progrès,—plus foudroyant, simultané pour tout le monde. Le télégraphe passe, brutal, et attriste d'un éclair des amis dispersés aux deux pôles. Le journal,—la bruyante machine qui fait chaque matin la voirie de la ville, balayant des idées, les faits et les morts de la veille pour laisser la place à ceux du jour,—le journal jette un nom dans la fosse commune des notices nécrologiques : Mariette, archéologue.—Qu'est-ce que cela ? auront demandé beaucoup d'honnêtes lecteurs, après s'être apitoyés sur la disparition d'un vaudevilliste célèbre, d'un acteur fameux ou d'un politicien illustre.—Mariette-Bey ? qui était ce Turc ? a peut-être dit quelqu'un en France. Puis la foule a oublié. Espérons pourtant que plus d'un lecteur français, parmi ceux qui surveillent en avares le trésor diminué de nos gloires, aura senti un coup au cœur en voyant s'éteindre une de ces gloires ; espérons qu'en tout pays bien des hommes, parmi ceux qui attendent de ce siècle une révélation de vérité, auront eu un cri de souffrance et de révolte devant ce méfait de la mort : l'ouvrier de génie pris à sa tâche en plein effort, en pleine promesse, au moment où il préparait la lumière qui sera l'aube de demain."

Here is a description of Mariette at home, among his household gods, the jealous guardian of the treasures he had collected for the Boulak Museum :—

"Tout le monde va en Égypte aujourd'hui, et, en Égypte, tout le monde va une fois au musée de Boulaq. C'est indiqué dans les guides entre la visite aux derviches tourneurs et la course au puits de Joseph. Parmi les milliers de touristes qui ont traversé depuis vingt ans le petit jardin du musée, beaucoup ont pu apercevoir dans la cour à main gauche, sous les acacias, un homme de grande taille, de forte carrure, vieilli plutôt que vieux, athlète pris rudement en plein bloc, comme les colosses qu'il gardait. La figure, haute en couleur, avait une expression songeuse et bourrue, bon enfant au demeurant ; il était vêtu de la stambouline et coiffé du fez. A sa mine placide non moins qu'à son costume, on le prenait volontiers pour un pacha turc ; il en avait l'allure fataliste et oisive quand il flânait dans son domaine, nourrissant ses singes du Soudan, regardant avec béatitude couler l'eau du Nil et luire le bon soleil voisin du tropique. Tandis que le visiteur traversait le jardin, ce propriétaire sourcillait d'un air rogue et fâché, il suivait l'intrus d'un regard jaloux, le regard de l'amant qui voit un inconnu entrer chez sa bien-aimée, du prêtre qui voit un profane pénétrer dans le temple. Cependant le petit ânier fellah tirait le touriste par la manche et lui montrait l'homme en articulant de son mieux : 'Mariette-Bey.'—Au sortir du musée, les voyageurs très consciencieux,—les Américains généralement,—poussaient jusqu'à la porte de la modeste maison, tout affaissée, et décrépite par les inondations du fleuve ; ils passaient leurs cartes ; le plus souvent on leur répondait que le bey faisait la sieste, ce qui était vrai. Avec un peu de bonheur, ils entraient et trouvaient un hôte silencieux, refrogné, qui leur demandait distraitement ce qu'ils avaient vu la veille à l'Opéra. Quand on le complimentait sur ses 'antiques,' il prenait l'air vexé d'un policier qu'on entretiendrait de son métier ; son expression de lassitude disait clairement : 'J'ai reçu huit ou dix mille touristes qui m'ont parlé des Pyramides ; je les ai montrées d'office à quelques douzaines de têtes couronnées, et comme d'ailleurs vous n'y entendez rien, j'aimerais bien causer d'autre chose ; j'aimerais mieux ne pas causer du tout.' Les curieux sortaient habituellement peu charmés.

"Parfois quand un jeune homme, un compatriote surtout, trouvait une phrase juste, un accent de curiosité sincère, le regard rentré du bey s'éclairait, se fixait sur l'inconnu, scrutateur d'abord et ironique ; si on le pressait sur le fait ou la date en question, il commençait par répondre, en haussant ses larges épaules : 'Oui, nous disons cela ; mais qu'est-ce que nous en savons ? C'est peut-être tout le contraire.' Il fallait alors,—hélas ! mon pauvre maître, je puis livrer le secret qui vous faisait parler, personne n'en usera plus,—il fallait alors abonder dans son sens et affirmer avec lui que l'histoire égyptienne est conjecturale, que l'art égyptien n'est pas de l'art. Aussitôt sa parole éclatait, abondante et irritée, il vous foudroyait de preuves, puis vous oubliait, s'oubliait lui-même et causait ; à ceux qui n'ont pas entendu cette causerie, rien ne saurait la faire imaginer ; ceux qui l'ont entendue ne l'oublieront jamais. La glace rompue, il vous prenait en affection, vous entraînait à son musée, et là il continuait devant ses vieilles pierres ; à sa voix, elles s'animaient, les momies se levaient de leurs gaines, les dieux parlaient, les scribes déroulaient leurs papyrus, les milliers de scarabées, symboles d'âmes libérées, emplissaient l'air du bourdonnement de leurs noms sonores et de leurs millésimes fabuleux. Au commandement de ce roi des temps, la procession des siècles retrouvés par lui se déroulait dans les salles funéraires ; ils revivaient tous, accablans de vieillesse et de grandeur, racontant les théodicées superbes, les civilisations inouïes, les conquêtes d'Afrique, les invasions d'Asie."

"On appelait volontiers ainsi 'le père Mariette,' et nul n'a mieux réalisé le type du genre que cet homme excellent et chagrin. Nos expositions parisiennes amenaient de violens combats dans son cœur; il craignait tant pour ses trésors les dangers du voyage, les aventures en lointain pays! D'ailleurs, à quoi bon produire les vrais dieux chez les infidèles, les profanes? Il n'en venait que trop à Boulaq. Aimant bien, il était jaloux, atrocement jaloux. Par boutades, il eût voulu tout enfouir à nouveau, pour lui seul. Il fit ainsi pour les tombeaux de Saqqarah, après qu'on y eut constaté quelques dégâts commis par des touristes stupides. Lors de mon premier voyage d'Égypte, en 1872, nous arrivâmes à Saqqarah avec quelques amis, sans Mariette; à notre demande de voir les tombeaux, son intendant nous dit qu'ils étaient comblés; comme nous nous récriions, l'Arabe reprit d'un air satisfait: 'Ce n'est rien, Mariette sait où ils sont.' Le bey avait soigneusement nivelé le sable et possédait seul, en effet, les repères de ses trésors. Cela lui suffisait; il se frottait les mains de la déconvenue des voyageurs. L'instant d'après, par une naturelle contradiction entre sa manie d'amant et son intelligence, il se désolait de ce qu'il ne venait pas assez de monde à son musée, de ce qu'on pouvait chercher en Égypte autre chose que ses sphinx et ses dieux, attendant les hommes de bonne volonté pour leur révéler les secrets de vérité."

Here is an item of history* which may serve to show that Mariette himself, during his early labours at Sakkarah, assisted in cultivating the taste of the present inhabitants of Egypt for the manufacture of Egyptian antiquities:—

"Mariette se fit contrebandier, et son génie brilla dans cet art comme dans tous ceux qu'il entreprenait pour les besoins de sa cause. À ce moment, notre savant passait ses journées à fabriquer des faux hiéroglyphiques; il sculptait des dieux, il barbouillait de rébus quelconques toutes les pierres blanches qui lui tombaient sous la main; on les chargeait ostensiblement sur les barques du Nil; les gens du pacha faisaient main basse sur la cargaison et séquestraient solennellement au Caire des documens dont quelques-uns portaient, en langage mystérieux, des légendes fort malhonnêtes pour Abbas. Pendant ce temps, les vraies stèles des Apis s'empilaient dans des sacs de sorgho, et les bons petits ânes d'Égypte, trottant toute la nuit dans les sentiers détournés du delta, les mettaient en sûreté au consulat de France à Alexandrie. Ce fut une armée de péripéties comiques et tragiques tour à tour. Un jour que Mariette partait lui-même pour Marseille avec le plus gros de son butin, les gendarmes du port envahirent le paquebot sous vapeur: le doux savant fit tête comme un lion, requit l'agent de France à bord, ordonna de lever l'ancre, rejeta dans un canot en haute mer les sbires fort déconfits, et apporta triomphalement sa bonne prise à notre musée national."

The death, in December, 1872, of the Viscount E. de Rougé, Conservateur des monuments Égyptiens at the Louvre, Director of the Egyptian section in the École des Hautes Études, &c., opened a way for Mariette's return to France, as the most worthy successor, but though he seems to have entertained the idea for a short time, it was easily dismissed from his mind, as M. de Vogüé, who was with him when the news came, tells:—

"Le nom de M. de Rougé me rappelle le violent combat qui s'éleva dans l'âme de Mariette en apprenant la mort du regretté professeur. Tous les bâtons de maréchaux de l'égyptologie se trouvaient libres, la chaire au Collège de France, la direction de la section du Louvre, le siège à l'Institut: nul ne pouvait les disputer au conservateur de Boulaq. Précisément, le bey venait de traverser une période de mécomptes et de froissemens; je le trouvai se promenant à grands pas dans son jardin et répétant d'un ton joyeux: 'Enfin, je vais partir, je vais les quitter: voilà ma place marquée en France; c'est une affaire finie.' Nous l'écoutions en souriant et nous lui disions à l'envi:—Non, maître, vous ne partirez pas, vous ne les quitterez pas, vos enfans de Boulaq, vous le savez bien; la France est ici pour vous, puisque vous seul pouvez la maintenir à cette place enviée, qui irait bien vite à d'autres.—Mariette se fâcha, jura que nous voulions son malheur, qu'il n'en ferait qu'à sa tête, . . et il ne partit pas. Le vieux savant montra qu'on peut mieux aimer la patrie en la servant au loin qu'en revenant y mourir."

Finally, this is M. de Vogüé's conception of the monument that should be raised by the French nation to Mariette-Pasha:—

* M. Alphonse Mariette, in a letter to the Secretary, says,—"I am free to admit that, even after my brother had become lord of all he surveyed, he was inclined to look complacently on the fabrication of antiquities (at Luxor and elsewhere), on the quaint plea that so long as tourists were content to buy the sham article, the real *antique* had a better chance of escaping."

"Il ne restera plus à la France qu'un devoir envers son grand enfant. Si nous étions à ces jours de la Renaissance, où le premier souci de l'état fut d'honorer les serviteurs de l'idéal, un vaisseau serait déjà parti pour l'Égypte ; il rapporterait un bloc de ce granit de Syène où l'on taillait les dieux, de cette pierre rose, brûlée de soleil, la pierre qu'aimait Mariette et qu'il disait être la plus belle de toutes ; on la confierait à un artiste capable de fondre dans son œuvre la liberté de la figure moderne et quelque chose du style hiératique de Memphis : le maître y revivrait, assis dans la grave attitude des sages d'Égypte, les mains sur les genoux, la tête ployée sous le poids de la pensée, rude et puissant comme étaient ses pharaons et comme il était lui-même. On dresserait le monument à la porte de son musée du Louvre, entre les sphinx d'Apriès ; il garderait là ses premières conquêtes, il introduirait dans le temple ceux qui croient à sa science, il y appellerait du regard et de l'exemple ces jeunes recrues qu'il s'affligeait toujours de ne pas voir assez nombreuses ; et comme l'éloge est plus doux dans la langue qu'on aime, on devrait graver sur le socle le beau témoignage du vieux Ptah-Hotep : 'Je suis sorti du monde ; j'y ai dit la vérité, amie de Dieu, chaque jour.' Ce qu'on écrivait, il y a quatre mille ans, sur le sépulcre de l'Égyptien, vous pouvez l'écrire sous le nom d'Auguste Mariette ; il l'a mérité."

Mariette became an Hon. & Corr. Member in 1861; on the 15th of August of the same year he was made an Officer of the Légion d'Honneur, and in 1867 he was promoted to the rank of *Commandeur.* He received the distinction of almost every other Continental Order, including the Red Eagle of Prussia. He took an active part, in an official capacity, in the Great International Exhibitions of 1862, 1867 and 1878. He was awarded the biennial Grand Prix (£800) of the Institut de France and the Gold Medal of the Royal Geographical Society. In 1854 he was made a Corresponding member of the Institut, and having, in 1877-78, resided continuously for a twelvemonth in France, he thus became eligible for full membership; in 1878* he was unanimously elected a member of the Académie des Inscriptions et Belles-Lettres, and on his first appearance after his election in that learned assembly he received an ovation of no ordinary character. As early as the year 1858 he was appointed by the then Khedive to the post of *Conservateur* of all the Egyptian monuments, receiving in 1862 the rank of Bey, and in 1879 that of Pasha. He died at Cairo, in his house† at the Boulak Museum, on Tuesday, the 18th January, 1881. Such was the respect entertained for him there and at Alexandria that the newspapers appeared in mourning, while the Government and the European communities united to give him an almost royal funeral. His body, laid according to his expressed wish, in a sarcophagus of the thirteenth dynasty, of his own choice, is buried amidst some of the treasures with which he endowed modern Egypt and enriched the world.

*** Since these notes were in type, a monument has been erected to Mariette-Pasha in his native town of Boulogne-sur-mer; it consists of a pyramid supporting a statue of the deceased master, the work of M. Jacquemart, the well-known sculptor.

* It is, perhaps, not generally known that no one is eligible as an active member of the Institut de France unless he has been domiciled within French territory for one whole year previous to his election. Hence the delay in receiving Mariette at the Institut—he having never, from 1850 to 1877, resided for twelve consecutive months in France.

† M. Rhoné, in *L'Égypte à petites journées* (page 61), very happily describes Mariette's residence:—"On trouve," he writes, "une petite place à l'entrée d'un vieux quartier, une grande porte dans un grand mur, et l'on entre : c'est le musée de Boulaq. Quelque chose de riant et de charmant apparaît tout d'abord : c'est une cour parsemée de vieux arbres, au fond de laquelle on voit couler le Nil. . . . À main gauche, dans la cour, s'élève l'habitation de M. Mariette et de sa famille ; à droite, la cour du musée, séparée de la première par une grille dont les piliers portent des moulages de ces petits sphinx qui, en 1850, mirent M. Mariette sur les traces du fameux *Serapeum* de Memphis. . . . . Le cabinet de travail de M. Mariette fait face au Nil, près de la porte d'entrée : Devéria nous y introduit, et nous trouvons le maître dans une grande pièce aux murs décorés de fresques à l'égyptienne, remplie de livres, d'antiquités, et d'où la vue plonge directement sur les ravissantes perspectives du Nil et de la région des Pyramides."

FREDRIK WILHELM SCHOLANDER, *Hon. & Corr. Member* (Stockholm).

IT would assimilate ill with the cold, quasi-judicial reserve of English criticism, or of an English obituary notice, to publish a literal translation of the many burning eulogies with which, in an infinity of ways, Swedish artists and writers have deplored the death of Scholander. The eldest son of Fredrik Georg Scholander and of Katarina Rebecka Nyström, he was born at Stockholm on the 23rd June, 1816. His father, a native of Landscrona, had, among other early vicissitudes, served for three years as a pressed sailor in the British Navy; his mother was the sister of Axel Nyström, an architect of distinction who studied in Paris under Hippolyte Lebas, and also at Rome, and to whom his country owes the foundation of that reform in Swedish architecture which Scholander afterwards developed. At sixteen he entered the Academy of Fine Arts, where, in the Architectural School then under the direction of Nyström, his uncle, he studied for about ten years. During that period he worked, for five succeeding summers, as a mason's apprentice, and took his "degree of master-mason" in constructing, trowel in hand, a stone staircase, which may still be seen by the curious in a dwelling-house at Stockholm. In 1841, after having obtained the chief prize in architecture, Scholander was appointed Academy Travelling Student, and started for Germany, France and Italy. In 1842-43 he worked in the *atelier* of Lebas, as his uncle had worked before him, and the twenty-two months he passed in Paris seem to have ever afterwards bound him with ties of gratitude to France. Much against his inclination he left the capital for the South of France, and stayed some time at Avignon, making sketches of everything interesting to the archæologist and the artist among the many architectural remains in Provence and the surrounding country. Continuing his journey through Italy, he reached Naples to revel in the treasures of Pompeii and Pæstum, arriving in Rome at the close of 1843. In the summer of the next year he again paid a visit to Naples, and then crossed to Sicily, making considerable stay at Palermo. Returning to Rome, he spent the winter of 1844 there, and the following summer in Lombardy and Tuscany, whence he was suddenly summoned to Munich.

This hasty termination to a student's travels—his term of academic studentship not having expired—was a terrible blow to Scholander, who had contemplated a visit to Athens, and even Egypt. But the summons to Munich was imperative. His uncle, Nyström, commissioned to prepare designs for a new Art Museum at Stockholm, was then at Munich, and desired his nephew to assist in their preparation. Scholander consequently left Italy in 1846. The Museum, however, did not make much progress, nor was Scholander the architect of it. Like the seven years' story of the Library Buildings of Martin Gropius at Berlin the Stockholm Museum will recall more than one parallel in England. The sum voted for the building was utterly insufficient, and Scholander knew it; he declined to attempt the work. A German architect of eminence, August Stüler, was intrusted with the design, which was carried out by a Colonel of Engineers, and the sum ultimately expended reached four times the amount for which Scholander had been originally expected to complete the building. Nevertheless he acquired a large practice as an architect, his principal works having been erected in Stockholm; but he retired soon after the year 1865, when a part of his official duties consisted in adjudicating upon designs sent in for public buildings, and he considered that he

had no right to carry on personal practice. In 1868 he became *Secrétaire perpetuel* of the Academy of Fine Arts, and ten years afterwards was appointed architect to the King and the Royal Castles. A little before obtaining this appointment he wrote, in March 1877, to Professor Donaldson an interesting letter, from which are taken the following extracts:—

Monsieur et très-honoré confrère,—D'abord je cherche les mots pour vous témoigner ma reconnaissance, due à votre bienveillance, dont je tiens la preuve par ce cahier qui doit me rappeler toujours votre qualité magistrale d'architecte, et votre bonté. Aussi je voudrais bien trouver un moyen pour vous la rendre pareille, mais dans ce moment-ci, je me vois réduit aux paroles seulement. Cependant, et comme dans votre bonne lettre vous venez d'exprimer le désir de savoir quelque chose sur l'état de nos affaires d'architecture hyperboréennes, je tâcherai de vous mettre au courant là-dessus, au risque de vous fatiguer par manque d'intérêt dans ma relation. Mais avant d'entrer en matière, je dois vous prévenir que je n'ai pas l'habitude de regarder les choses en blanc et rose,—au contraire ! Ayant longtemps vécu et étudié en France et en Italie, mes yeux sont toujours restés ouverts vis-à-vis l'impuissance de nos efforts, dans un pays, très heureux du reste, mais un peu negligé par le soleil, dont les rayons tièdes ne suffisent guère pour faire éclore la belle fleur de l'art, ni pour semer le germe du beau dans l'esprit des habitants. Cela n'empêche pas les Suédois d'être accessibles aux impressions nobles de l'art, mais, vous le savez bien, Monsieur, il faut que de longues suites de générations s'adonnent au culte de la forme et de la couleur pour que ces deux bases de l'intelligence artistique se transmettent dans le sang et deviennent propriété nationale. . . . .
. . . . Sous Gustave et ses fils, Eric et Jean, devenus rois l'un après l'autre (1523-1594), fut la première ére de l'art, proprement dit, en Suède ; et les artistes qui y contribuèrent en premier lieu étaient deux frères, Domenico et Giovanni Battista Pahr, Hollandais par naissance, mais sortant de l'école italienne, et ce qui reste de leurs travaux me rappelle, d'une manière frappante, le sentiment des "fratelli Lombardi" dans les profils et d'autres détails. Ces artistes bâtirent et aggrandirent plusieurs châteaux, dont la plus grande part n'existe plus, et comme Gustave savait bien l'art de faire prospérer le commerce et l'industrie du pays dont il venait de sauver la liberté, il eut à sa disposition des richesses considérables. Aussi aimait-il de les étaler par une magnificence inconnue jusqu'alors dans les résidences royales du nord. Mais dès qu'il fut mort, l'ancien jeu de la guerre recommençait, le trésor se vidait peu à peu, et ce ne fut qu'avec grande difficulté que ses fils pouvaient satisfaire à leur goût très développé pour la belle architecture. Elle s'en allait avec eux. Le petit fils de Gustave, Gustave Adolphe, dit le grand, relevait la noblesse, et en éloignant la guerre de sa terre natale il procurait à ses généraux et guerriers les clefs des trésors de l'Allemagne en même temps qu'il distribuait entre eux des domaines considérables. Aussi depuis 1600 jusqu'à 1660 ne faisait-on que très peu d'architecture et on y voit toujours l'empreinte ignoble de la "baraque" allemande. Mais après la guerre de 30 ans, la noblesse fit embellir ses possessions par des châteaux en grand nombre, presque toujours d'une bonne disposition des plans, mais élevés à la hâte et presque sans détails, rien que des murs pilastrés, sans chapiteaux ni bases, etc. Deux Français : de la Vallée père et fils, et après eux un Allemand : Tessin—homme de grand valeur comme architecte—avec son fils Nicodemus Tessin, travaillaient durant cette période d'une très grande activité. Tessin fils voyagait beaucoup et exerçait son art dans le style de Fontana et à la Louis XIV. Le château actuel de Stockholm fut son œuvre principale. On avait alors à vider le trésor de Charles XI, trésor qui fut ramassé par la violence de l'autocrate, qui força la noblesse de rendre tous les domaines et l'argent donné par les rois précédens, ou accaparé d'une manière ou d'autre par eux, au détriment de l'état. Pour l'achèvement du château royal, dont les travaux continuèrent pendant tout le temps, et malgré les guerres désastreuses, de Charles XII, on fit venir sous son beau frère et successeur Frederic (1730) toute une colonie d'artistes français à Stockholm, et ce fut eux qui fondèrent notre Académie en 1734. Mais en même temps l'architecture commença à tomber. Et elle tomba, tomba, faute de nourriture, car la nourriture de la déesse s'appelle entre autres choses l'argent, et on n'en avait pas. Gustave III, un roi très éclairé et d'un goût élevé, toujours selon la mode de son temps, bien compris, et auquel nous devons tout ce que nous possédons de statues et d'ornements antiques au musée national—il achetait à Rome la belle collection de Piranesi—Gustave III, dis-je, fit bien élever des choses merveilleuses, mais, par malheur, ses projets se bornaient à des décors de théâtre. Et puis vint le nadir, ou, plus encore, l'éclipse total du style, manque absolut d'ouvriers et de matériaux—un sommeil profond et continuel, jusqu'au retour de l'Italie de Nystroem. Lui, c'était bien l'homme qu'il fallait pour recommencer. Mais, bon Dieu des architectes ! quelle tâche à emplir ! Quelle besogne à faire : agir comme le Créateur lui-même; faire sortir du néant un art, une école ; ouvrir les yeux aux aveugles, frapper pour faire ouvrir les oreilles assourdies et les bourses bien fermées ; lutter contre les préjugés, l'ignorance, l'envie, la calomnie, la défiance et tout ce qu'il y a de noir dans la nuit. Il

commencait, il montait, mais il avait toujours sur ses talons une meute formidable de chiens acharnés de journalistes et d'ingénieurs, qui ne voulaient guère lacher prise. Il fut nommé professeur à l'Académie en 1832. Il fallait d'abord se défaire des anciens élèves qui ne savaient rien et ne voulaient rien apprendre. Ils publièrent sur leur maître des caricatures infâmes. Enfin, le voilà seul avec des nouveaux adeptes, qu'il put former selon sa manière, et mettre dans la bonne voie ; et il s'en occupait jusqu'à 1848, laissant alors sa place sans regret, car il savait bien que ses doctrines salutaires ne seraient point abandonnées ni désavouées par son successeur. Nommé architecte de la ville de Stockholm (1846) et Intendant des bâtiments civils de l'État, il céda aux autres de s'amuser à faire de l'art ici, mais, passé 65 ans, il se retira des affaires, ne gardant que sa charge de Secrétaire à l'Académie, dont la réorganisation était son œuvre. . . . . .

Or, on comptait l'an de grâce 1844 lors de l'arrivée au trône du Roi Oscar I. Pour célébrer le commencement de son règne il fit élever un musée qui devait coûter la somme de 41,750 livres st. demandée à la Diète, dont les deputés criaient comme s'il s'agissait d'entrainer la ruine du pays par cette extravagance. Un allemand, feu mon ami Stüler à Berlin, eut l'honneur d'étre appelé par le Roi pour faire le projet, et le monument fut exécuté en pierre calcaire taillée, sous la direction d'un officier de génie. La dépense montait à 208,333 livres st. ! La secousse fut un peu rude, mais aussi amenait-elle des suites étonnantes. Tout le monde s'éveillait. On commencait à remuer l'argent et les fonds ; la construction des chemins de fer fut votée, on se mit à bâtir des églises, des fabriques, des maisons, toutes sortes de choses. Et cela a continué jusqu'à la dernière guerre, mais, vous devinez le reste. On attend, attend—qu'est-ce qu'on attend, puisqu'on n'ose plus rien entreprendre ? Mais, effet inattendu des grands travaux chez nous ! En améliorant d'une manière saillante les conditions de l'ouvrier, ces travaux ont amené la décadence de leur habileté, et dans ce moment-ci on est vraiment réduit au désespoir quand il faut entreprendre une construction quelconque. Ajouter à tout cela, s'il vous plait, que les matériaux—la fabrication de briques, par exemple, ne va pas en s'améliorant—et nos fôrets s'en vont à l'étranger ; ce qui nous reste n'est plus d'une qualité assez bonne pour être exportée, et ne devait pas servir dans la bonne construction d'après nos méthodes. Enfin, la bâtisse est devenue tellement coûteuse que personne n'y pense, à moins qu'il ne s'agit d'entreprises dont les avantages sont incontestables.

Pour vous donner une idée de notre architecture il suffit de dire qu'on n'a jamais les moyens nécessaires pour se servir de la pierre de taille autrement que pour les socles des soubassements, quelquefois un portail, etc. ; tout le reste se fait en briques couvertes à l'enduit (de la chaux et du sable) dont on file aussi toutes les moulures, corniches, chambranles, etc. Vous vous imaginez bien, Monsieur le Professeur, le peu de valeur que cela donne au caractère d'un édifice même si les rapports en sont bons du reste. L'enduit donne toujours un petit goût de pâtisserie à l'architecture et bien mieux vaudrait-il se servir de la construction crue ; mais cela devient trop cher, vu que nous n'avons pas de bonnes briques, ni la fabrication perfectionnée des ornements en terre cuite. Seulement on a commencé depuis quelque temps d'employer du ciment pour l'ornementation, et cela vaut mieux que le mortier et le plâtre. Mais le cas est toujours que l'architecture reste pieds et poings liés, sans possibilité de s'élever audessus du médiocre. . . . .

Et si vous voulez bien me permettre de dire un mot sur moi-même, je confesse d'avoir abandonné l'architecture en exécution depuis l'inauguration de la Synagogue, je ne me souviens plus au juste l'époque, 1866 je crois. J'en ai assez comme Intendant du Gouvernement et professeur, et je ne m'occupe plus du reste que de la peinture à l'aquarelle, car "on revient toujours à ses premières amours," et c'était malgré moi que je fus architecte ; c'est feu mon oncle, plus tard mon beau-père et maître, Nystroem, qui me fit embrasser la carrière détestée. Et pourtant je suis encore en relation avec mes anciens camarades d'étude chez "Père Lebas" (mon maître à Paris), et en Italie, et vous connaissez bien les noms de Lefuel, Ballu, Paccard, Garnier (dont j'étais le "patron" à l'atelier, et qui est venu me voir à Stockholm), mais ces relations ne regardent plus l'architecture comme autrefois, c'est que eux-mêmes en ont assez, sans cela. . . . . .

C'est avec le plus grand estime, du à votre renommée d'artiste et à la bienveillance dont vous venez de faire preuve à l'Académie, ainsi qu'à moi-même, que j'ai l'honneur de signer avec dévouement, Monsieur le Professeur, votre très-humble serviteur,

F. W. SCHOLANDER.

P.S. Si, par hasard, vous voyez M. Wyatt, architecte (*the late Sir Digby Wyatt*), il se rappellera, peut-être, de moi. J'avais l'honneur de faire sa connaissance à Rome, mais il y a bien longtemps de cela. Cependant une fois, à l'occasion de la première grande Exposition à Londres, il a bien voulu me faire parvenir sa carte.

The reference to his return to his "premières amours," and to his having been forced to follow the "carrière détestée" of architecture is qualified by an anecdote given in a notice of Scholander, published by the *Finsk Tidskrift*. "Had he been left to choose,"

writes the author of that notice, "he would have exchanged the compass and rule for the brush and palette. But, in after years, he used to say, 'thank God I was not permitted to do as I liked.'" That he took the ultra-artistic side in architectural polemics is certain, and in the then condition of Swedish art it was admittedly the right course to adopt. But under his tuition and from his example great results were achieved, and if Sweden is now, so it is said, in possession of a distinctive style or school of architecture, it is due to the energetic initiation of Scholander. Described as the pride and the mainstay of the Academy of Arts, it is only natural that he should have regarded architecture principally from the academic point of view. Writing some two years ago to a former pupil he lamented over certain changes which were taking place. "Realism," said he, "the Moloch of modern times, has again swallowed a victim. The architecture-division of the Academy of Arts has been transferred to the Institute of Technology. The young architect, who, hitherto, has breathed the air of arts, lived in the society of artists, and worked side by side with them, is now to become an engineer. His brain which, previously, was filled with colour, form and poetry, is now to be crammed with calculations."

Scholander in his leisure hours painted, wrote poetry, and sometimes added music to his compositions and ballads. He first published in 1860, under the pseudonym of "Acharius," and his poems, which are numerous, were often illustrated by himself in water-colours, or in pen-and-ink. From the year 1868 he made an annual report on the progress of art, and latterly these reports have been printed in the public journals, which (at least those that have reached England) describe Scholander as the foremost man, in his particular sphere, of their time and country. He was familiar with French, German and Italian, and he could read English. A notice of his life and works, written in French, and sent to the Institute by Dr. Nyström, his brother-in-law, is preserved in the library. It breathes the same spirit of affectionate reverence that has inspired the Swedish journalists, as may be seen by the following extract:—

"Dans notre pays, relativement pauvre, où l'on veut pourtant suivre l'exemple du combat des grandes nations européennes sur l'arène de la culture moderne, c'est une suite naturelle de la population peu nombreuse que le système de la division du travail ne peut être appliqué comme sur le continent populeux. Il arrive en conséquent assez souvent de nos jours, et chez nous, qu'un génie qui s'est montré propre sous un rapport, est ensuite censé propre à tout, ou au moins à beaucoup, et une universalité s'est déclarée chez nos hommes les plus éminents qui cherche son pareil parmi d'autres nations, plus favorisées par la nature. Mais de tous ces génies universels, aucun n'a été sur un terrain aussi vaste, et sous chaque égard aussi richement et réellement doué, que Scholander; tout dilettantisme, si ordinaire en tel cas, fut ici d'avance exclus, par suite de son aversion naturelle vis-à-vis de tout ce qui, n'étant pas pleinement entier et réel, se présentait avec cette prétention. Scholander était, comme il n'y a que peu, né artiste 'par la grâce de Dieu,' et comme tel il ne tournait point sa vue d'un seul côté, mais il embrassait d'un regard souverain tout le monde du beau en quelle direction que ce soit—fût ce pour créer quelque chose de nouveau et d'originel sur des prémises données ou pour analyser avec le lorgnon du juge critique ce qu'avait pu produire une période, un pays, un art quelconque ou un seul artiste. C'est donc notre avis que le plus grand génie artistique suédois de ce siècle, son esprit le plus lucide et originel, vient d'être enterré avec Scholander."

Scholander was elected an Hon. & Corr. Member in 1877, and the following year he obtained from the Institut de France the honour of Corresponding member. He was also a member of the Danish Academy of Arts. At home, he was Hon. Doctor of Philosophy in the University of Upsala, Professor of Architecture and Secretary at the Royal Academy of Sweden, Sub-Commissioner in the Department for Public Buildings, a Member of the Swedish

Academy for History, Antiquities and Literature, Commander of the Order of Wasa, Knight of the Orders of the Northern Star and St. Olaf, &c. The news of his death on the 9th May, 1881, was immediately communicated to the Institute by Dr. Nystróm, who once before had performed a similarly sad duty on the death of his father, Axel Nystróm, elected an Hon. & Corr. Member in 1855, " a distinction," to use Dr. Nystróm's words, " very highly prized both by my father and by my late cousin and brother-in-law." The funeral honours rendered to Scholander by his countrymen were marked by the presence of the Prince Regent representing the King, and of the high functionaries of State, together with deputations from the various societies to which the deceased architect belonged, and a vast concourse of people.

KONSTANTIN ANDRAIVITCH THON, *Hon. & Corr. Member* (St. Petersburg).

WHEN it is remembered that, in the year 1865, the Russian artists presented the subject of this notice with a crown of laurels and a medal commemorative of the fact that he had then attained the fiftieth anniversary of his professional life, it will be felt that his was no common career and that the master in his own line of so long and eventful a period must have been no ordinary man. Konstantin Andraivitch Thon was born in St. Petersburg at the end of 1794, and he died in February, 1881, being then, consequently, in his 87th year. It appears from a biography printed at the time of his jubilee, that Thon was admitted into the Imperial Academy of Fine Arts at the age of nine years, and that he commenced the special study of architecture some six years afterwards. At that time (1809) the Russian curriculum of study for an architect was in some measure re-organized. A naval officer was appointed as teacher " for the better success of the mathematical class, in which the pupils of the architectural class were studying." He taught twelve hours every week. Besides this there were lecturers who treated : (1) On the application of geometry to the calculation of surfaces and the density of matter, land-surveying and levelling ; (2) on statics and dynamics ; (3) stereometry ; (4) application of statics to the calculations of machines, the theory of the arch, the laying of pavements, wall and roof trusses, the pressure of water and earth ; (5) building estimates and quantity calculations. A part of the reforms then introduced was a reminder to one of the professors to teach his pupils : (*a*) Perspective ; (*b*) the theory of civil architecture in connection with the solidity, arrangement and ornamentation of buildings ; (*c*) the history of architecture and of distinguished architects. Further the professor was ordered to impart " the common ideas of natural philosophy, which may be useful in the choice and preparation of materials." The half-yearly examination, however, was not a satisfactory one as regards the pupils of the perspective class, and censure was expressed. In 1811 there was another examination and things were better ; in 1812 the professors were thanked, for things were better still, and in 1813, when the lists of students who had distinguished themselves were presented to the Minister of Public Instruction, the name of Thon appeared first in the class of architecture. Between that period and the year of his leaving the Academy (1815) Thon gained several medals and was finally placed fifth in the list of those who received the first-class diploma.

In 1816 the Emperor Alexander I decreed the formation of a committee for the better

arrangement of buildings and hydraulic works in St. Petersburg. The duties were to examine all government and private designs for new buildings, for restoring old buildings, and for executing a system of water-pipes and other hydraulic works. Thon, in some capacity, was connected with this committee. A short time afterwards the travelling fund of the Academy was re-established, and in 1819 Thon was one of those sent abroad by the Russian Government with an annual allowance for three years. He passed through Berlin, Dresden, Vienna, Venice, Bologna, Florence, Sienna, and arrived in Rome towards the close of 1819. Staying there till the following spring he then started for Naples and Sicily and returned to Rome in the autumn, when he began a design for a Russian Church on the principle of the Roman basilica; and amongst a variety of similar works, continued for several years in Italy, he made drawings of restorations of the Temple of Fortune at Præneste, of the Palace of the Cæsars* in Rome, and of Hadrian's Villa near Tivoli. These he presented to the Academy, and the attention of the Emperor having been given to them, Thon was rewarded with an appointment in 1828, which brought him back to St. Petersburg; and two years afterwards he was made a member of the Academy.

His first work of importance at home was the re-construction of a portion of the building in which the Academy was housed, a work that was eminently successful and one which sufficed to establish Thon's reputation as a practical architect. At that time there was talk in St. Petersburg, as there had previously been in other European capitals, of a revival in the forms and details of church architecture, and Thon entered heartily into the spirit of it. A large Cathedral was to be constructed at Moscow; Thon was ordered to design it in the "old Russian style," and this work was not entirely completed in 1865, when, as before mentioned, the fiftieth anniversary of Thon's professional career was celebrated by his colleagues and pupils. Numerous churches were designed and their construction superintended by Thon, and he prepared, for the use of the Government, model plans of churches to seat congregations of 1,000, 500 and 200 as the case might be.

In the year 1837 the Emperor Nicholas decided to restore portions of the Kremlin of Moscow, and he caused a special programme to be prepared for the re-construction of the Palace, desiring to associate it in the minds of the Russian people with the traditions of their Czars. The work was intrusted, in 1838, to Thon, and occupied him for some sixteen years. The new cathedral, in the Kremlin, which was rising at the same time—also intrusted to Thon—was finished in the rough about the year 1854, and this equally with the Palace, is an outcome of Russian patriotism. Other works, such as the restoration of the Steeple of Ivan the Great, as it existed before 1842, were also executed by Thon according to the Imperial commands. Nor was he debarred from carrying-out buildings of a more prosaic character than these; the railway stations on the line from Moscow to St. Petersburg were designed by him, and the terminus of the latter city was completed in 1850.

The jubilee of Konstantin Andraivitch Thon, Rector of Architecture in the Imperial Academy of Fine Arts, was the occasion for reference to the vast improvement effected in the

* The following work in the Institute Library, namely, *Il Palazzo de' Cesari sul Monte Palatino restaurato da Constantino Thon, illustrato da Vincenzo Ballanti. Roma, P. la S. T.* mdcccxxviii, was presented in February, 1857, by the Rev. Richard Burgess, who described himself as a Corresponding Member of the Archæological Academy at Rome, and of whom notes are given at p. 59.

arrangement of Russian buildings, and to the emancipation of architecture, as it was and is still called elsewhere than in Russia, from the bonds of academic tradition. A perusal of his biography only serves to confirm the fact that in the great empire of the Czar, as in all other countries, the nineteenth century has witnessed an onward movement in the practical knowledge and public appreciation of architecture. "Russian architecture," writes one of his biographers, "is improving day by day. . . . . If we leave the decoration of the exterior, paying attention only to the plan of modern habitations, and in this plan confining ourselves to the comfort and practical considerations of every-day life, we shall recognize as still more important the great step which our architecture has made during the last twenty or thirty years. It separates us from the architecture of the past, which did not accommodate itself to the necessities of life. . . . . We can see now how much the present age demands, and how little was demanded by the past. . . . . The reformation has come about, to all appearances, almost insensibly, but it was not so: there was a struggle, there were enemies, there were unexpected blows. . . . . It required one determined man, possessing strong will, as well as knowledge of the mysteries of the art; when he appeared the new life was communicated, and the progressive movement began. . . . . This showed itself first in church architecture, and notably in the five-steepled churches for which the designs of Professor Thon were rigorously accepted as the model. . . . . No doubt but that numerous persons have directly and indirectly influenced the movement which has taken place, yet it must be admitted by the most prejudiced judge of Thon's career that he occupies the leading position as an actor in it."

A part of the ceremonies connected with the jubilee, in 1865, consisted of a grand banquet, at which the Professors Konkornik and Resanoff addressed the Rector in glowing terms of affectionate eulogy. In all 180 sat down to dinner, and these were principally the pupils of Thon. The immense reverence felt for him by them was reflected in the address delivered by Count Steinbock, Vice-President of the Academy, as the following extract shows:—

"Honourable Gentlemen,—We have all met here with a noble and only object, worthy of our century: that of doing justice to what we may term progress. This object, which I feel sure, Gentlemen, you are all prepared to acknowledge, is to offer our congratulations for the benefits conferred on society by the original productions designed by our countryman, Konstantin Andraivitch Thon. On this day, half a century has elapsed since he commenced his career as an architect, after having completed his studies in the Academy. It is a known fact that our architect applied the whole of his energies, his remarkable talents and assiduous attention, not to one or two works only, but to all and every work that he daily undertook. He modelled his mind by careful assiduity and perseverance during the years of his classical studies, as well as in later years, by his endeavours to acquire knowledge and to find fresh ideas from any ancient monuments. He soon reaped the benefit of his persevering application, and developed considerably his natural capabilities. The attention of our Gracious Monarch was attracted by the superior talent of the architect, who was authorized by his august master to execute some extensive works, in which his abilities were brought to light, and his superiority gained wide reputation. The time came when the sublime magnificence of holy temples erected over the whole extent of the country inhabited by Russian people called for special designs in the shape of edifices appropriate for such purposes in our century, and in accordance with the requirements of worship and the local exigencies of our northern countries. Professor Thon satisfied the wants of the period, imparting to the old buildings such improvements and appearance as were most adapted to our modern age; he did not merely imitate, according to events and tradition, he was always ready and able to create from his own imagination with extraordinary and real talent; the variety of his designs was endless, and they were appropriate to the conditions and requirements of respective localities. He would have the remembrance of his successors even without having done anything more important, but the opportunity was given to him alone to create something independent and original, when called upon by the Superior will to build in the very heart of Old Russia some part of the Kremlin of Moscow. The artist was obliged here to compete with all the

surrounding specimens of ancient art, every one of which had for the local inhabitants some sacred traditional meaning. Artistic features or qualifications were obliged to be secondary to the above considerations. Such a man would not be forgiven even the smallest faults. Still he overcame this opposition, and presented to his country a monument of the magnificence of the Monarch which will obtain for him, among all other names, that of constructor. This hall, in which we now celebrate the jubilee of the Professor, is his own creation; not a very important one compared with other of the Professor's buildings, but one of those which could be counted by tens in a long list of his works. Certainly you, Gentlemen, can recognize the severely studied proportions of this gallery, where the talent and knowledge of the artist were first manifested. But I am sure you cannot realize how deep was the impression made at the time. I had the good fortune then to be one of the pupils of the Academy, and I have a lively remembrance how unanimously the visitors expressed flattering eulogium on this new ornament of the academic building, and how we children attentively listened to their words. But neither his wide activity nor quickness in invention in the new projects of different kinds which sprang from him—not by years, not by months, but by days—diverted the attention of the devoted Professor from guiding the young talents along the ground which he himself had passed over. Two hundred pupils whom he has educated prove better than any phrases how he regarded this important cause during the thirty-four years of his professorship."

Professor Thon was elected an Hon. & Corr. Member in the year 1868. The news of his death was communicated to the Institute by Professor Resanoff, *Hon. & Corr. Member*, to whom the Secretaries are much indebted for information respecting Russian architects.

JOHN HENRY BROWNE, *Associate*, died on the 18th of October, 1880. He was articled to Messrs. Rhodes and Chawner (both deceased), Surveyors to the Office of Woods, Forests, Land Revenues, Works and Buildings, and those two gentlemen, with the late Mr. David Mocatta, supported his candidature as an Associate, to which grade he was elected on the 8th of July, 1839. He was for some time in the late Sir J. Pennethorne's office. He was engaged during the whole of his professional career for Lord and Lady Holland, on the restoration of Holland House, the improvement of the Park, and the development of the Building Estate; he was engaged also on Lady Holland's house and grounds at St. Anne's Hall, Chertsey. He retired from practice about 1873, and spent the latter years of his life at Wymondham, in Norfolk, with which county his family have been long connected.

EDWARD M. FORSTER, M.A., *Associate*, was elected in 1876. He was a pupil of Mr. A. W. Blomfield, who recommended him for nomination. He died on the 30th of October, 1880, and left a small legacy to the Architects' Benevolent Society.

ANTHONY SALVIN, Jun., *Fellow*, was the son of the late Anthony Salvin, F.S.A., *Past Vice-President*, who survived him. He was elected an Associate in 1850, and became a Fellow of the Institute in 1861. He was a great invalid and died in 1881.

*** REV. RICHARD BURGESS, B.D., *Hon. Member*.—This once familiar and welcome lecturer at the early meetings of the British Architects in Covent Garden, in Grosvenor Street and in the present house, expired at Brighton in April, 1881, at the age of 84. His original connection with the Institute will be best shown by the following extract:—

Royal Institute of British Architects, 16, *Grosvenor Street*.

We, the undersigned Fellows, do hereby nominate and recommend to the Council for election as *Honorary Member*, the Reverend Richard Burgess, B.D. of Chelsea, Author of the Description of the Circus on the Via Appia at Rome, of a work in 2 vols. 8vo. on the Antiquities of Rome, of Travels in Greece, &c., all of which have been presented to this Institute. Mr. Burgess has also read three Papers before the Institute on the Edifices in the Roman Forum, and on the Palatine Hill, as also upon arrangement, &c. of Christian Basilicas. We conceive these works and papers to be of sufficient importance to entitle him to such distinction.

Witness our hands this 25th day of June, 1839,

Thomas L. Donaldson.
P. F. Robinson.
Charles Fowler.

Elected this 8th day of July, 1839, Decimus Burton.

He was one of the Prebendaries of St. Paul's, a learned archæologist, and one of the most genial of men. The following list of his literary works is extracted from the Catalogue of the Institute Library:—

Circus on the Via Appia, near Rome; with some Account of the Circensian Games.—8°. *Lond.* 1828.
Topography and Antiquities of Rome: including the recent discoveries made about the Forum and the Via Sacra.—2 vols. 8°. *Lond.* 1831.
Greece and the Levant.—2 vols. 12°. *Lond.* 1835.
Recent topographical discoveries in the Roman Forum and adjoining parts.—SP. 15 May, 1837.
Antiquities of the Palatine Hill at Rome.—SP. 26 June, 1837.
Form and parts of Ancient Christian temples, commonly called basilicas.—SP. 24 June, 1839.
Construction and uses of the Ancient Circus.—SP. 18 May, 1840.
Nomenclature, forms, parts and uses of the temples of Greece and Rome.—MS. SP. 7 June, 1841.
Thermæ of Ancient Rome. From the *Civil Engineer, &c. Journal.*—pamph. 4°. *Lond.* 1842.
Thermæ of Ancient Rome.—SP. 30 May, 1842.
Aqueducts and Walls of Ancient Rome.—SP. 29 May, 1843.
Walls of Ancient and Modern Rome.—SP. 12 May, 1845.
Ancient triumphal Arches.—SP. 20 Apr. 1846.
Theatres and Porticos of Ancient Rome.—SP. 12 June, 1848.
Mausoleum of Hadrian, now the Fort S. Angelo at Rome.—SP. 4 Mar. 1850.
Ancient Roman roads, and Modern British railways.—SP. 30 June, 1851.
Topography of the Roman forum and the Clivus Capitolinus.—SP. 28 June, 1852.
Ancient basilica as compared with the early Christian temple.—SP. 27 June, 1853.
Topography and Antiquities of Constantinople.—SP. 26 June, 1854.
Egyptian Obelisks in Rome, and Monoliths as ornaments of great Cities.—SP. 31 May, and 14 June, 1858.
Water Supply of Ancient and Modern Rome.—SP. 12 Mar. 1866.
Stamboul and the Bosphorus.—SP. 7 June, 1869.

The Paper (mentioned above) on the "Nomenclature, forms, parts and uses of the temples of Greece and Rome," bears the title in the author's handwriting, *De Templis Deorum.* It seems to have never been printed in any of the journals of the day, and it does not appear in the volumes of TRANSACTIONS. The greater part of it is here published for the first time:—

NOMENCLATURE, FORMS, PARTS AND USES OF THE TEMPLES OF GREECE AND ROME.

HAVING had the honour of appearing before you for several successive years in the capacity of Lecturer, I seem to have acquired a prescriptive right to lay this annual embargo upon your time and attention, and as from the very first (dating my career of Antiquary from Covent Garden) I have made a periodical offer of my poor services to your valuable Secretaries, I may cite myself as an instance of the great danger which attends the voluntary principle, for now it would be very difficult for my friends of the Institute, who know my ambition, to avoid when the proper season returns giving me something of an invitation; on the other hand I take care with becoming modesty to ask for an evening when my lucubrations will not prevent any other member's elucidations, just as a man asks you to dine with him if you have no better engagement, meaning all the time that his is the best engagement the guest could possibly meet with. But, however, as I have before remarked, this annual infliction upon your patience and attention comes of your own indiscretion, for since you enrolled my name in the list of your honorary members, I have been endeavouring to justify that act, not so much for the sake of establishing my title to the distinction as for saving the reputation of those friends who committed the error of counting me in the ranks of literature and science.

The subjects, too, on which I profess to treat are circumscribed within so narrow a limit that I always fancy, when I make my annual appearance, that some one is whispering to his neighbour, "Ecce iterum Crispinus," for temples, baths, porticoes and theatres, with a little iconography, form about the whole territory in which I can pretend to expatiate. You have already listened patiently to my arrangements for the Roman Forum, and you have found your way with me on the Palatine "o'er steps of broken thrones and temples," you have followed me into the ancient Basilicas used for christian churches, and lastly I led you a chace of seven times round the spina of the circus, and now diving once more into the recesses of my antiquarian portfolio there come out the Temples of the Gods, and this is the subject which I propose to bring before you this evening, and perhaps I shall be excused if I have already sprinkled a little incense upon you before I have reared my altar.

In proportion as religion partakes of superstition it becomes a more effective and important engine of state policy, and therefore, whilst the Philosopher of the Pagan World regarded all religions as equally absurd, the magistrate (as a cunning historian has observed) regarded them all as equally useful. The superstition of the senator and the peasant (observes the same writer), of the poet and the philosopher, was derived from very different causes, but they met with equal devotion in the Temples of Gods. The religion of polytheism was admirably adapted to engage the attention if it did not secure the respect of the multitude, and the system of an elegant mythology could not fail to amuse and delight the warm imagination of the poet and the artist. Destitute as paganism was of any of those ennobling motives which revealed religion inspires, it seems to have expended its strength in refining upon objects of the senses until, like the shades of departed heroes, whom it sometimes represented, it melted away into invisible air, and I do not know whether to say it died at last of a plethory of invention, or of a consumption for want of the nourishment of truth. However these things may

be, the history of polytheism, as it may be traced in the forms, parts and uses of its temples, must ever be a subject of interest to the artist, and especially to the architect, for he is indebted to it for the best and purest specimens of his art, and among the "remnants of things that have passed away," he finds none so useful to his studies as the vestiges and relics of ancient temples. Whilst, however, the student of architecture can contemplate with delight the perfection of the art in those remains which time has preserved, and whilst he can indulge his appetite in devouring the beautiful proportions of a full-grown temple, a more severe task is imposed upon the antiquary. He must investigate with patience the steps by which the temple rose to its perfection; he must dig under the altar and penetrate the thick grove to ascertain, if it be possible, how the god was removed from his seclusion and set upon a pedestal protected from harm by a comfortable niche; he must deal with the fancies of etymologists and pursue an intricate mythology which leads him through the heavens after having tired him by terrestrial expeditions; and in short, if the architect can restore the broken fragments to their places, and pencil leaves wanting in the capital, the antiquary is expected to give a reason why Venus should preside over the finished work instead of Mercury, and the edifice should be called an *Ædes* instead of a *Delubrum*. The consequence is, that the eyes which were open in admiration at the ingenious elevation restored, begin to close at the dry researches of the antiquary, until he finds that the god Somnus has usurped all his honours. In the hope that that drowsy deity may find no votaries in this inaugurated hall on the present occasion, I shall proceed to speak, first, of the origin of Temples.

The most magnificent temple, which the ancients imagined, and which preceded all their notions of buildings made with hands, was the vault of Olympus, in which they supposed the great Jove to reside. Hence old Ennius sings, "Contremuit templum magni Jovis altisonantis." At a very early period dark caves and hollow rocks were considered as temples, and the pagan had a special veneration for thick groves and woods, where "Echo from her sister Silence flew." "Trees," says Pliny, "were temples, and to this day the simple rustics consecrate a very fine tree to the gods." The first moveable object that was introduced into those temples of nature was an altar, on which to place with more convenience the sacrifice. Sometimes altars were reared as memorials of events,—a custom in all probability derived from the Patriarchs. Tacitus tells us of altars and groves in the island of Mona in the time of the Cæsars. Among some nations of antiquity the introduction of sacred edifices was effectually resisted. The Persians had no temples of the Sun, because they said that his resplendent majesty could not be contained within walls. The doctrine of the Scythians, the Afri and Numidians, was similar: that the gods ought not to be confined; and long after temples were introduced into Greece some adhered to the old doctrine. Hence about 300 years after Epimenides, who is believed to be the inventor of temples, Zeno Citticus and his followers declaimed against building new temples, although they tolerated those that were already in existence. This doctrine of not confining the deity within walls may have been derived from the Israelites,—a sublime idea expressed by Solomon at the dedication of his temple in inspired language. "The very heaven of Heavens cannot contain thee; how much less this house that I have builded?" The altar having been introduced on which to lay the sacrificial offering, the next step was to set the statue or image upon the further side of the altar. It was soon found necessary to shelter the *head* of the figure from the effects of the sun and rain, and this was done by placing over it a circular shade, called the "nimbus," a specimen of which may be seen on a bas-relief on Constantine's arch at Rome. This "nimbus," which had its origin in the simple expedient of preserving the heads of statues, ended by becoming the distinctive mark of gods and goddesses most venerated, and finally it was adopted by the Christians and converted into a radiant emblem of glory to distinguish the heads of Christ and his Apostles, as we constantly see in old missals and other devotional books of the Roman Catholic and Greek Churches. But if the statue of the god was thus furnished with a parasol, it could hardly be expected that the officiating priest would long remain without an umbrella; for, as the altar with its deity emerged from the *tesqua loca*, or cool shade of the grove, and the ceremonies were lengthened, it became necessary to improve and enlarge the shelter; the statue, which had only the defence of the "nimbus," was next secured on all sides except the front, which required to be seen in the worship, and this was the origin of the niche. The priest who had only had a *thensa* or awning held over him, now stood under a permanent roof, made to imitate the vault of Olympus, and this being subsequently inclosed by walls on the sides produced the *cella*. When this was complete by putting doors in front (as architecture advanced to perfection) it was called a *sacra cella*, contracted into *sacella* or *sacellum*, which we may translate "chapel;" and when two columns were introduced in Antis, it might be designated an *Ædicula*. The sacellum was generally erected by the sides of public roads to afford facilities to travellers to pay their vows. There was an Ædicula in every street of ancient Rome, 423 in number. Another edifice of this smaller class was called a *Lararium*, which did not differ much in its construction, but was used for the service of the Dii Lares, whom we may designate without any offence the Lilliputian gods.

But the Sacellum, the Ædicula and the Lararium, although originating in the first rude attempts to rear the sacred edifices (*Ædes sacræ*) to the gods, were subsequently perfect buildings in themselves, and exhibited the characteristics of their respective uses. I have mentioned them now in order to dismiss all further consideration of them from our subject, and that I may proceed with the growth of the genuine temple from the period when the god began to be properly housed, and the sacerdotal attendants sheltered from the fervent rays of Apollo, and the drenching embraces of Jupiter Imbrius. As the number of the sacrifices increased, and with them the attendant worshippers, it became necessary to provide accommodation for the people also. This was not done by enlarging the cella, so as to include the multitude within walls, but by adding the portico. It seems probable that the first description of portico was that called by Vitruvius a prostyle, which signifies that there were columns in front only. The temple of Antoninus and Faustina, that formerly of Bacchus near the grotto of Egeria and the Pantheon, all at Rome, are prostyle temples. When there was a portico in the back-front also it was an amphiprostyle, and if the portico ran all round the edifice it was a peripteral temple.

If instead of one row of columns there were two, it was called dipteral, but if while there were two rows in the front,—the proportions of the inner and outer rows being as four to ten,—there was only one running along the flanks, it was then a pseudo-dipteral. The temple of Venus and Rome is a pseudo-dipteral (vide plan); it is also an amphi-prostyle, and as it had ten columns in front the intercolumniation being two diameters, it was also a decastyle sistyle. I have now only to mention a monopteral portico, which was generally round, and was an open temple, something like our English kiosks in gardens, columns supporting a roof, under which stands a round table to support the good cheer of pic-nic parties. But a peripteral temple might also be round, as, for instance, the temple of Vesta at Rome, or of the Sibyl (so called) at Tivoli. There is at Pompeii a triangular shaped temple, which is nevertheless peripteral, because its columns run round it. Any place surrounded by columns without the *corpus internum* of an edifice, was a peristyle—the whole inclosed space being exposed to the open air (in such a building Augustus slept in the summer months). A temple has sometimes an open roof, as the temple of Neptune (I think) at Pæstum, and such a temple Vitruvius would have called an hypæthral. All these derive their architectural appellations from the nature of the portico, without any reference to the order, or to the deities to whom the edifices were dedicated.

There are several words which we translate by the general term of "temple," but which had all a special signification. All the edifices of the gods were consecrated, but they were not all inaugurated, and some buildings or objects which were not used for religious worship, yet, having had the intervention of the Augur, were called *templa*. Livy calls the Rostra in the Forum from whence the orators addressed the electors a templum, the Curia Hostilia. The small houses of Pompey attached to his theatre were called *templa*, not because they had anything of the form of a temple dedicated to the gods, but because the Augur had performed his rites over them, and made them not *sacra* but *sancta*. An edifice erected to a deity and consecrated by the Pontiffs, was an *Ædes Sacræ*. The adjective was generally dropped, and the building called an *Ædes*. Hence it will be understood that all edifices set apart for religious uses were *sacra*, but they were not all *sancta*. Sometimes they were both consecrated by Pontiffs, and inaugurated by the Augurs, and then they were sacro-sancta, a compound of holiness which is now generally applied to the most venerated Basilicas of modern Rome. Temples were said to be "effata" by the Augurs, and "consecrata" by the Pontiffs. But wherever we find an edifice for religious worship, called a "Templum," we must understand that it had some additional dignity, and had been honoured by the augural ceremonies. A *Fanum* might only be a site consecrated for a temple, and when so consecrated it was generally inclosed until the individual should have it in his power to finish the building he had vowed to raise to his patron god. Romulus vowed to build a temple to Jupiter Stator, but Livy tells us it was only a fanum until Fabius, after a victory gained over the Samnites, finished it, "ut Romulus ante voverat. Sed fanum tantum id est locus templo effatus jam sacratus fuerat" (Livy, Lib. x. 37). Sometimes a space in front of the fanum was left open and not included in the survey of the Augur or the Pontiff; this space was called the locus profanus, a word which was originally intended to express no more than the space in front of the consecrated site, into which any one might enter without ceremony; but now to call the portico or porch of our churches "profane places," would be considered an outrage to be dealt with only at the tribunals of our chief Pontiffs. Another name for a temple of the gods was "delubrum," more frequently in the plural number "delubra." The proper definition of a delubrum is a temple which contained several deities, or a place where water ran in front of the building. A delubrum required that there should be space enough within the inaugurated inclosure to admit of altars on which sacrifices in the open air might be performed to the respective deities, supposed to reside in the precincts. According to some supposition it was a place which contained basins for washing dead bodies, as the temples of Apollo at Delphi, and of Jupiter at Dodona, where there were large cauldrons and tripods kept. The temple of Venus and Rome was a delubrum, or more properly delubra. It might also be called a fanum, indeed, it is so called by Aurelius Victor in his Life of Maxentius. It might with equal propriety be called a templum, because it was inaugurated, and it might be spoken of as an Ædes much in the same general way as we apply the word church to a building, which resembles a barn equally with our St. Paul's and Westminster Abbey. You will have perceived that I am not pursuing a chronological history of the rise and progress of temple architecture, for the Vitruvian terms I have already used for the most part apply to a period when architecture had passed its meridian in Greece, and was now in perfection at Rome. Nevertheless, you may perceive in these differently formed porticos, beginning from the statue on a pedestal, and following the ground plan down to the temple of Venus and Rome, the gradual improvements which one age made upon another, and how every addition to classical architecture is accounted-for upon the principles of utility and accommodation. Hence I should conclude that, in the inventive department of that art, it is not necessary to adhere closely to those ancient models, but considering architecture as guided mainly in its execution by the principles of utility, and, we may add, steering its course by the suggestions of climate, place, and national custom, it is allowable to depart from those models of antiquity, and adapt the ark to the changed circumstances of time, place and climate, and if any modern Vitruvius should arise to give us precepts altogether new, and issue "positive orders" hitherto unheard-of, I should not, until I had examined his propositions upon their own merits, reject them because they differed from the orthodox proportions of the Propylæa and the Parthenon, or were unlike any ancient buildings inhabited by gods or men. . . . .

I have now spoken of the origin of temples, tracing them from the statue in the niche to the Parthenon with its splendid portico; I have mentioned the different kinds of porticos to which the Vitruvian terms are applicable; I have attempted to give you some explanation of the words used in classical authors to designate the several descriptions of sacred edifices; I have glanced at what I may be allowed to call the philosophy of architecture, by giving you some examples of the taste and propriety observed in adjusting the style of the edifice to the character of the imaginary inhabitant, and finally I have cited the specimens which all-devouring Time has left us of those models of antiquity, and now before I proceed to name two or three of the most

renowned temples of Greece and Rome, I will ask you to accompany me into a temple, and for this purpose let us take the temple of Venus and Rome, whose remains are sufficient to enable us, with the aid of medals and notices of ancient writers, to restore the whole to its pristine magnificence.

This, however, I shall preface by giving you some account of the erection of this temple from the remains of which, and with the aid of medals extant, we have been enabled to adjust the ground plan and restore the magnificent elevations. The Forum of Trajan was erected by the celebrated architect Apollodorus, and the skill displayed in that splendid work excited the envy of the Emperor Hadrian, who, upon some frivolous pretext, drove the object of his emulation into exile. The Emperor, who was passionately attached to the Arts, resolved to build upon his own plan a temple which should rival the works of Apollodorus, and that he might convince the exiled architect how easily his services could be dispensed-with at Rome, he sent him the designs of the temple which was then in building, and triumphantly asked him his opinion. Dion Cassius informs us that Apollodorus, nothing daunted, returned an honest opinion upon the design. He told the Imperial Architect that his temple ought to have been more lofty; that he should have made it with subterranean accommodation for receiving, as occasion might require, the machines and apparatus of the adjoining Amphitheatre, and that he ought to have given it a more imposing aspect towards the Via Sacra; the statues (and this severe remark cost the critic his head), he observed, were disproportionately large, and, being put in the niches in a sitting posture, if they wished to get up and walk out at the doors they would not be able. From this reply of Apollodorus we learn sufficient respecting the position of the temple, its vicinity to the Colosseum, its flank towards the Via Sacra, to be sure that the ruins I am about to describe are those of the temple built by Hadrian. It was called sometimes Templum Urbis, and indifferently Templum Romæ, Veneris, or Veneris Romæ. It was a double temple as the plans exhibit it. That part dedicated to Rome looked towards the Capitol; the statue of Venus towards the Amphitheatre. It is just mentioned in Spartianus's Life of Hadrian, and also by Amm. Marcellinus; and according to the Chronicon of Eusebius it was built in the year 132: "Templum Romæ et Veneris ab Hadriano factum est quod nunc Urbis appellatur." The only description we have of it, except the slight notices to be gathered from the critique of Apollodorus, is found in a minor poet, Prudentius contra Symm. *lib.* I, 218:—

"At sacram resonare viam mugitibus ante
Delubrum Romæ: colitur nam sanguine et ipsa
More deæ, nomenque loci ceu Numen habetur;
Atque Urbis Venerisque pari se culmine tollunt
Templa, simul geminis adolentur thura deabus."

Which you will perceive is accurately descriptive of the double temple. But although the notices of this great edifice are so scanty in ancient writers, the two medals which we have representing this temple, and the remains which were brought to light in the excavations of 1828, enable us to restore the whole upon good authority. Being present at Rome when those excavations were going on, I was induced, with the aid of an ingenious Italian architect, to undertake the restoration of this temple, and you see before you a copy taken from the engravings in the first volume of my "Antiquities of Rome." I now proceed to the description:—

The inaugurated ground upon which this splendid edifice stood, opposite the Colosseum, was surrounded, except in the main front, by a portico or peristyle, of grey granite columns, 200 in number; within this peristyle, and in the middle of the flanks, were erected two triumphal columns, as the medals exhibit, and as you may see in our restored elevation. Like all other temples of dignity this had first an area, or a space in front of the platform, for profane uses; it was probably secured at proper seasons by a loose barrier, but within it the victims and other objects used by the votaries of the deity residing within the edifice were exposed for sale. From this area we ascend by steps, in this instance, on account of the want of space, ingeniously contrived at the extremities of the front, but in other cases running along the whole length. Those steps were commonly of an odd number, so that the worshipper who ascended to the Atrium might begin and end with the right foot, for to step into the temple with the left foot was considered a bad omen. The threshold, or *limen* was sacred, and the gods expected that their suitors would show them proper respect by kissing it before they proceeded further. I shall not ask you, gentlemen, to perform this ceremony, but shall at once allow you to enter into the portico, and before you enter you may regale your sight with the splendid elevation, where you perceive the ten columns supporting the pediments filled with the exploits of the deities to which the temple was dedicated, and through the columns you can see the *fores* or doors, by which was the entrance into the *cella*. Passing the front row of the ten columns we approach an inner row of four, and find ourselves within the body of the edifice, but not within doors. This part of the temple was called by the Greeks *Prodomus*, and more often *Pronaon*, obviously so-called because it was the space immediately before the habitation of the deity, or that which was properly the *naos*, and which we have hitherto called the cella. Open the doors, which were generally of bronze, and we enter the cella where the statue of Venus, in this instance in a sitting posture, receives our homage. If we had entered by the back portico we should have found *Roma sedente* in the same relative position. The section which is given in our restoration will show you the interior of the cell, which I shall now proceed more particularly to describe. With reference to temples in general, behind the altar and the statue which occupied the main niche there was room for persons to pass, and if necessary to get under the altar, and deliver the oracle from the hollow shrine. This was called the Adytum, and the astonished multitude, not being acquainted with the secret recesses and the ingenious devices of the sacerdotal tribe, heard the voice of the god speaking, and believed the deity to have taken up his abode in the simulacrum which represented him. The subterranean vaults, where the implements and machinery of worship were deposited, and where in case of need persons might take refuge, were called the *Penetralia*, and the recesses which contained the presents brought to the deity were called *Sacraria* or *Donaria*. These internal arrangements of the temple, especially the trick of the Adytum, and the convenience of the Penetralia have

been discovered at Pompeii, and the honesty of the Pagan priesthood declared to all. But besides the statue of the principal deity the walls of the cell contained other niches for the images of accompanying gods. In that of Venus there was room for ten such, and all were no doubt well occupied. The interior of the cell was fitted up wiih a variety of splendid furniture for use or ornament. There were *Lectisternia* and *Pulvinaria*, which we may translate Dover chairs and sofas for the gods to recline upon at their ease; there were chariots of all descriptions dedicated by successful and grateful combatants, Currus, Bigæ and Quadrigæ adorned the walls, or were suspended from the roofs like the trophies of Victory in our Chelsea Hospital; there were Coronæ, Vittæ, Tæniæ, which the most skilful of our bonnet makers might have coveted as models for our modern Venuses' head-dresses; there were Spolia and Exuviæ, which the devotees might not have come by honestly, but which, however, free from selfishness rather than superstition, they gave to the goddess; there were Vota and Anathemata in abundance, the grateful offerings of those who had received, or fancied they had received, help from the gods; there were sigilla, seals or stamps, and perhaps cameos, in their respective repositories; there were Clypei (shields) and divers kinds of military armour, "their bruised arms hung up for monuments." Upon all these the presiding deity looked down with complacency, and the voice from the adytum took care that no one with a weighty present for the god should go away without thinking himself a better man. But the most valuable works of art which adorned the interior of the temple were undoubtedly the statues and the pictures. With regard to the statues it may be enough to mention that the Venus de Medici found in the fish market at Rome once adorned a temple within the portico of Octavia. The Apollo Belvedere, the Capitoline Venus, the Meleager of the Vatican, and those other exquisite specimens of the art of sculpture, show what the temples of gods contained when art was in its perfection. We wonder not that a people whose imagination loved to revel in a mystic theology should bow down before those exquisite forms. But time which has spared the marble forms has had no mercy on the perishable paintings, so that with the exception of some frescos rescued from subterranean damps, or found in the houses of Pompeii, which give us some specimens of their composition and colouring, we have no means of ascertaining what the works of Zeuxis or Polygnotus might be. We have an intimation in Pliny that even prior to the building of Rome admirable paintings decorated the ancient edifices of Italy. He mentions the Atalanta and Helen of such surpassing beauty that Caligula would have carried them away, if the nature of the materials had permitted it. But I am not about to enter into a dissertation on ancient paintings; I only wish to call your attention to the fact that paintings were considered a necessary embellishment for the most splendid temples.

In May, 1858, two excellent Papers were read in Grosvenor Street, one by Richard Burgess on Obelisks and Monoliths, the other by John Bell, the sculptor, on the application of the entasis to the obelisk. The discussion on both Papers was taken at the next meeting, and the whole proceedings may be read in the TRANSACTIONS, 1857-58, pp. 175-191. A passage from the concluding paragraphs of the former Paper, which is a happy illustration of the author's style, is here given :—

I shall not attempt to invade the special province which Mr. Bell is to occupy this evening, but, if I may, I will give him this word of sympathy before he begins, that I am a believer in entasis, and I should not regret to see my shafts (providing the points are not touched) shooting up from his ornamental basements; but I am particularly anxious to enlist your sympathies for the monolith obelisk as an ornament and durable memorial suited to such a metropolis and such a nation as this. I have no respect for this placing one stone upon another when we have a public monument to erect in honour of a great man; they will all be loosened and want repairing long before Macaulay's New Zealander contemplates the ruins of St. Paul's while standing on a broken arch of London Bridge, but a monolith, if set up in front of the Exchange, might survive to indicate at the end of 3000 years, where the three per cents were once done at 98. Besides, the discoveries which have been made in the most ancient writing of the world are rendering hieroglyphics every day more interesting, and none have more cause to rejoice than we, who are the interpreters of our sacred books, in the results of this modern field of literature. Every colossal figure disinterred where Nineveh once stood, and every papyrus that is unrolled confirms the accuracy of our sacred history, every obelisk deciphered contributes something towards completing the succession of the Kings of Egypt. We shall soon know the line of Pharaohs from the time of Abraham to the reign of the Ptolemies, and the impugners of the chronology of the Old Testament history will have to go into obscurity before the petrified sun's rays of Egypt. There is something of a Providence in this which we cannot but admire, that in an age remarkable for its craving for material proof of every proposition, which believes little except that which it can see and taste and handle, an age in which scientific discovery had begun to wave the flag of triumph over revolution, there should have been left concealed in the earth, or hid from the knowledge of man, a series of evidences which have proved the accuracy of those Scriptures which were given to make men wise unto salvation. I look forward to a great advancement in this walk of literature. I see no reason why in the course of another generation our national schoolmaster should not by way of a treat to a dozen of his best boys take them out on a half holiday to read the obelisks that may be set up in Trafalgar Square (when it is a square), or Palace Yard, when it becomes an open court, or on the table land of Hyde Park, or in front of Buckingham Palace, and that the name of Victoria in hieroglyphical signs be as familiar to the eye as "God save the Queen" is to the ear. Have you not all read with perfect ease the hieroglyphical name of the Emperor Domitian, and could not every one here present make a phonetic Victoria and Albert for himself?

III. EARTHENWARE POTS (BUILT INTO CHURCHES), WHICH HAVE BEEN CALLED ACOUSTIC VASES. BY GORDON M. HILLS, *Associate.*

[Read on Monday, 21st November, 1881, T. Hayter Lewis, F.S.A., *Vice-President*, in the Chair.]

THE occasion of my putting these notes together was the discovery in August, 1878, of about fifty earthenware pots built into the nave walls of Leeds Church, near Maidstone, Kent. As no collected description exists of the previous discoveries of the kind, I have thought it a fitting opportunity to put together the various notices which I have been able to gather from sources much scattered.* Both in French and English publications the discovery of one or more pots built into church walls and laid with their opening towards the interior of the church, has been invariably designated in the present century as the discovery of "acoustic vases" or "acoustic pottery." The assumption that pots of the various forms so placed were designed for acoustic purposes rests on the text of Vitruvius, repeatedly quoted or referred-to; on a passage in the Chronicle of the Monastery of the Célestins of Séans, at Metz; and on another old reference to the subject little known.

That acoustic vases were used in the time of Vitruvius, *i.e.* in the time of the Emperor Augustus, is not to be doubted. In his fifth book, and the fifth chapter, Vitruvius says, "On the foregoing principles," viz. the principles of harmony laid down in the fourth chapter, "the brazen vases are to be made with mathematical proportions, depending on the size of the theatre. They are so formed as when struck to have sounds, whose intervals are a fourth, fifth and so on consecutively to a fifteenth. Then between the seats of the theatre, cavities having been prepared, they are disposed therein in musical order, but so as not to touch the wall in any part, but to have a clear space round them and over their top: they are fixed in an inverted position, and on the side towards the scene are supported by wedges not less than half a foot high: and openings are left towards the cavities on the lower beds of the steps, each 2 feet long and half a foot wide. The following is the rule for determining the situations of these vases. If the theatre be of moderate size, they must be ranged round at half its height. Thirteen cavities are prepared at twelve equal distances from each other, so that those tones above named, producing netè hyperbolæôn, are to be placed in the cavities at the extreme ends; second from the ends, the vessels are to be of the pitch of netè diezeugmenôn, bearing an interval of one-fourth from the last mentioned. The third netè paramesôn, an interval of another fourth. The fourth netè synemmenôn, another fourth. The fifth mesè, a fourth. The sixth, hypatè mesôn, a fourth: in the centre of the range, hypatè hypatôn, a fourth. By the adoption of this plan the voice which issues from the scene, expanding as from a centre and striking against the cavity of each vase, will sound with increased clearness and harmony, from its unison with one or other of them." So much I have quoted at length from the translation of Vitruvius† by the late Joseph Gwilt. Vitruvius goes on to say, that if the theatre be of a larger scale, three ranges of cavities are to divide its height into four equal parts. The lowest range of cavities is to have vases as those already described, *i.e.* of the harmonic genus;

* In vol. XVI, p. 359-363, B. A. A. Journal, 1863, is an article by Mr. H. S. Cuming on Hollow Pottery used for constructive purposes in building.—G. M. H.

† See Appendix A.

the middle range is for those of the chromatic genus, with somewhat similar names for the tone of the vases, but the centre cavity left vacant: the upper range is for diatonic vases, and every cavity to have its vase. For his acquaintance with the subject Vitruvius acknowledges himself indebted to the writings of Aristoxenus, and makes the important statement that no such furniture or arrangement existed in any of the theatres at Rome. This he argues is because the Roman theatres, being of wood, which is a very resonant material, did not require them. Yet, he says, some theatres in the provinces of Italy possess these vases, and many in the Grecian States. And by way of showing that Rome was not wholly without evidence of such things, Vitruvius adds that "L. Mummius, on the destruction of the theatre at Corinth, brought to Rome some of its brazen vases and dedicated them as spoils at the temple of Luna." But all this relates to brazen vases, which seem much removed from our poor subject of earthenware pots; the relationship is, however, supposed to hang on the final sentence of Vitruvius, where he says, "Many clever architects who have built theatres in small cities, from the want of other, have made use of earthen vessels, yielding the proper tones, and have introduced them with considerable advantage."

So far as is known at present no other scientific rule or practical statement referring to the use of vases for acoustic purposes can be produced till after an interval of many centuries. In A.D. 1432 an arrangement of urns or pots was introduced into the Church of the Célestins of Séans, at Metz, the capital of Lorraine, and it was there introduced at the instance of the Prior of the Monastery, Père Ode-le-Roy, who had been struck with the good effect of it in another church, where he had been attending a Chapter-general of the Order of Célestins. In the last months of the year 1861, the remains of the Convent of Célestins of Metz were pulled down by the French military engineers, a circumstance which induced Mons. E. de Bouteiller, member of the Imperial Academy of Metz, to publish all he could collect of the history of the monastery. He gives extracts of a Chronicle of the Monastery from A.D. 1371 to A.D. 1469, from a MS. of the end of the fifteenth century in the Town Library. Mons. Didron, editor of the *Annales Archéologiques*, gave a wider circulation to the extract relating to acoustic pottery by inserting it in his publication, at page 296 in the volume for 1862, from whence I reproduce it. The record of the Metz MS. is as follows:—"En cest année* dessus dit, ou mois daoust le vigile de l'assumption Notre Dame, aprez ceu que frère Ode le roy, priour de seans, fuit retournez du chapitre g^ral de dessus dit, il fit et ordonnoit de mettre les pots ou cuer de leglise de seans portant quil avoit vu altepart en aucune église, et pensant quil y fesoit milleur chanter, et que il ly resonneroit plusfort. Et y furet mis tuis en ung jour ou point tant douvrier quil souffisoit. Maix ie ne seay si on chante miez que on ne fasoit. Et cest une chose à croire que les murs en furet grandement crolley et deshochiet et becop de gens qui viennet seans sont bien merveillez que y soye fait. Et dixent aucune foix qui valeoit mieux quil furet aprésen dehors, portant que lon pensoyt il seroit là mis pour en prendre et jouyr à plaisir aux foulx." Some ancient scribe has noted his opinion of the wisdom of the Prior's contrivance by writing in the margin of the MS. "Ecce risu digna."

* A. D. 1432. See for this extract page 110 of the pamphlet by M. Ernest de Bouteiller entitled *Notice sur le Couvent des Célestins de Metz*, Metz, 1862, 8vo. The extract is quoted by Didron *ainé* in the *Annales Archéologiques* (1862), vol. xxii, page 294, and also by Viollet-le-Duc in the *Dictionnaire raisonné de l'Architecture Française*, vol. vii, page 471.

The Abbé Cochet has produced another reference to the use of jars for acoustic purposes in a work of the year 1665, entitled "L'Apocalypse de Méliton."* The author dilates strongly on the negligence of their duties by the religious orders, and gives this instance among others—"Of fifty singing men that the public maintain in such a house, there are sometimes not more than six present at the service; the choirs are so fitted with jars in the vaults and in the walls that six voices there make as much noise as forty elsewhere." This author believed therefore in the efficacy of the contrivance for acoustic purposes.

If records of the practice are scanty, so are examples. Of the period antecedent to Vitruvius it has been attempted to draw examples of the practice from the ancient Chaldea. In *The Builder* for 1857, page 470, in reviewing the "Travels and Researches in Chaldea and Susiana," by W. K. Loftus, the editor calls attention to "a very interesting and curious example of decorative architecture" discovered by Mr. Loftus at Warka. A piece of a wall 30 feet long was found, for a portion of its surface 14 feet 10 inches long, faced with the bases of terra-cotta cones, the bodies of the cones being embedded solidly in mud and chopped straw. Some of the bases bore red and some black colour, and these were so arranged as to mark out coloured patterns on the face of the wall, such as diamonds, triangles, zig-zags and stripes. A writer in *The Builder* for 1863, page 820, attempts to connect this discovery of Mr. Loftus's with "Acoustic Pottery," but there is not a word in the original article, or in the description of Mr. Loftus, to justify the attempt. The editor of *The Builder* expressly describes it as "decorative," and not acoustic, architecture, and Mr. Loftus compares it with decorative pottery found in Egypt.

Of classic times the only examples relating to acoustic vases that have been quoted, in addition to those mentioned by Vitruvius from the Theatre of Corinth, are pointed-out by Mr. R. R. Brash, an Irish antiquary and architect, in *The Gentleman's Magazine* for December 1863. He cites Belli, and on his authority states that the greater theatre at Hierapytna in Crete had at least one row of bronze *echeia*. From Falkener's *Museum*† for 1854, he says that at Lyttus there were three rows. From the Transactions of the Royal Irish Academy for 1790 he produces Conyngham's testimony that there appears to have been a similar provision in the ancient theatre at Saguntum; from Irby and Mangle's *Travels*, that the ancient theatre at Scythopolis in Syria has seven recesses for *echeia* in the position indicated by Vitruvius, and that Texier found similar arrangements in a theatre at Aizani in Asia Minor. As I understand it, all these examples relate only to recesses which the various authors assume to have been intended for the reception of brazen or earthen vases, such as Vitruvius describes to have been securely placed, but not built or bedded in mortar, in the recesses.

* See page 42 of *L'Apocalypse de Méliton ou Révélation des mystères cénobitiques par Méliton*, Sainct Leger, 1662, 12mo. Two other editions of this satire, published at Saint Leger (Luxemburg), appeared in 1665 and 1668. *Méliton* was the pseudonym of Claude Pithoys, who also wrote *Traité curieux de l'Astrologie, &c.*, Sedan, 1641, 8vo. The complete passage, referred-to by Mr. Gordon M. Hills as having been quoted by the Abbé Cochet is as follows : "Que sçait ce que l'on fait derrière ce rideau? de cinquante *Choristes* que le public entretient dedans telle maison, quelques fois ils ne seront pas six à l'office ; ces chœurs sont accommodés avec des pots dans la voute, et dans les murailles, en sorte que six voix y feront autant de bruit, que quarante ailleurs. C'est le portique d'Athènes appellé *heptaphonon*, ou une voix resonante au septuple, par une forme d'Écho, un moine modéré appelleroit ceste industrie, *une pieuse fraude*."

† *A description of some important Theatres, &c., in Crete; from a MS. History of Candia, by Onorio Belli in* 1586. Lond. 1854, 8vo. (See Appendix A for this and other references in the paragraph.)

All the mediæval examples of so-called acoustic vases have been found solidly built into walls. The resonance of vases, however sensitive their material to the vibrations of sound, must thus have been completely destroyed. Until the discovery of the Metz Chronicle, it was not unreasonable to doubt whether any of them could be called "acoustic." I begin the mediæval examples with those from the continent.

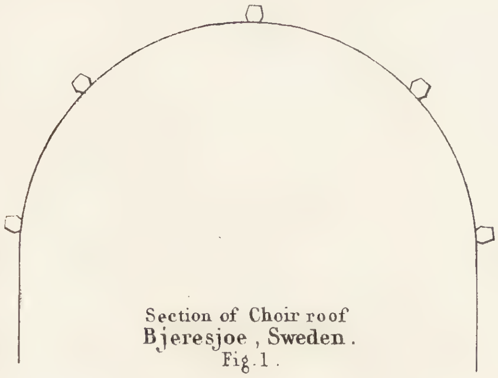
In 1862 Mons. Didron was visited at Paris by two Russian gentlemen, Mons. Wladimir Stassoff, editor of the official Archæological journal of St. Petersburg, and Mons. Gornostaeff, member of the Imperial Academy, who, in questioning him as to acoustic pottery in French monuments, informed him that Mons. Stassoff had found these cornets and acoustic pottery in a very great number of ancient Byzantine churches, or Greco-Russian churches in his country. Mons. Stassoff promised Mons. Didron a detailed communication on the subject, but I am not aware that the promise has been fulfilled. There are several works by Mons. Stassoff in the library of the British Museum, and I have looked at two, which, by their date subsequent to 1862, might have contained a fulfilment of the promise, but I do not find it.

In 1861 Mons. N. M. Mandelgren, a Swedish architect, paid a visit to Mons. Didron at Paris. He had found in Sweden and Denmark a pretty considerable number of churches furnished with earthenware pots built into the walls and vaults, with their openings turned towards the interior of the building. I believe this is the same gentleman who, in visiting England some eight years previously, created a good deal of interest by his descriptions of the timber churches of Norway, and the early carvings of that country. Some of his drawings were published about that time by the Cambridge Camden Society. Mons. Mandelgren promised Mons. Didron to give some particulars of this "moyen d'acoustique." The only fulfilment of this promise, with which I am acquainted, is given in a work on the painted decorations of Scandinavian churches, published in Paris by Mandelgren in 1862. The book is a large thin folio,* exhibiting fine specimens of mediæval architectural painting. It contains illustrations from about eight stone built and vaulted churches, besides timber built churches. The first of the stone built churches is that of Bjeresjoe in Sweden, and in this one only is the subject of the pots used in the construction of the work, shown or alluded to. The author gives no opinion as to their use, merely restricting his mention of them to urns built into the vault of the choir and the apse. The church has no aisles. The nave has a simple tower at one end, the chancel at the other, with an apse for the altar. The entire building is vaulted over with stone; the nave having two bays of groined vault, the choir a simple barrel vault, and the apse a half dome. The entire length within the walls scales about 80 Swedish feet, or 78$\frac{3}{4}$ English feet. In external form its respective parts are not unlike the well known Norman church of Kilpeck in Herefordshire, but the latter has no tower, and we should call the Swedish example later Norman than Kilpeck.

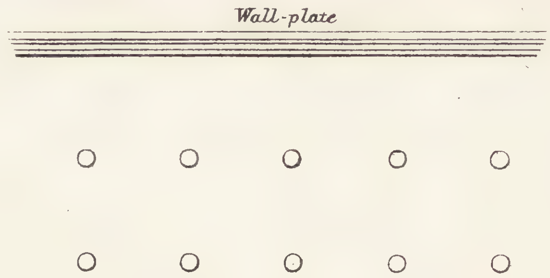
Mandelgren does not tell us how the urns are arranged in the vault of the apse. As he expresses his inability to say how many urns are used altogether, except approximately (he should think forty to fifty), I gather that only some are to be seen where the plaster on the vaults is broken down. He considers that all were plastered over and out of sight. The provision for receiving the plaster over them is remarkable, and, I believe, unique. The urns

* *Monuments Scandinaves du Moyen âge*, &c., Paris, 1862, folio, plate II., B, B, B. (See Appendix B.)

EARTHENWARE POTS (BUILT INTO CHURCHES) WHICH HAVE BEEN CALLED ACOUSTIC VASES (No. 1)

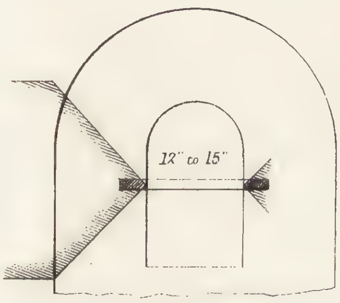


Section of Choir roof
Bjeresjoe, Sweden.
Fig. 1.

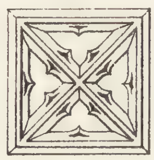


Swiss.
Fig. 2.

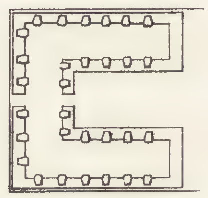
SKETCHES, NO SCALE.



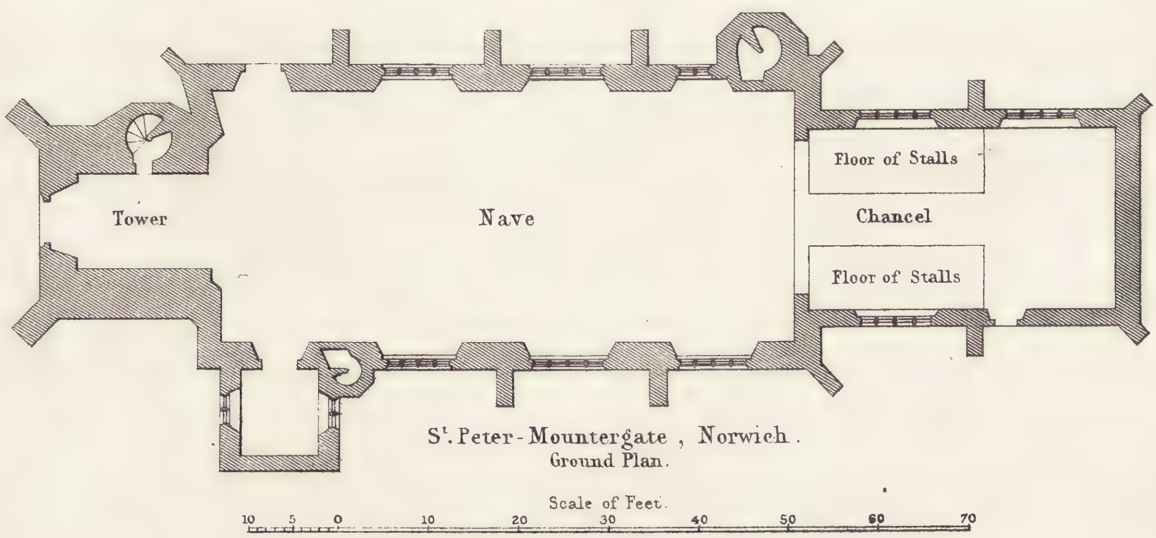
Leeds, Kent.
Fig. 3.



St. Mary's, Ipswich,
Tower.
Fig. 4.



Typical Plan.
Fig. 5.



St. Peter-Mountergate, Norwich.
Ground Plan.

G.M. Hills, del.

J.P. & W.R. Emslie, lith.

in the choir vault are arranged in five rows longitudinally, viz. one along the crown of the vault, one at each side of the vault, just above its base or springing, and one along each haunch of the vault (see Illustration No. 1, fig. 1). In the rows the urns are about 18 to 19 English inches apart, and as those in the haunches are not shown in the cross section of the vault, but only the bottom rows and the top one, I judge that they alternate over the spaces between the pots, like the portholes in the side of an old fashioned three-decker man-o'-war. The urns are shown with their mouths to the inside of the church. The largest diameter of the urns is at the mouth, which is about 6½ English inches, and the depth is 9 inches; the diameter at the back or bottom of the urn is 3¾ inches. The bottom is quite flat. The material is clay, and resembles in colour and baking the urns found in Swedish tumuli. The general shape is given in Illustration No. 2, fig. 1; the covercle to the mouth is a piece of oak a quarter of an inch thick, 11 inches long, and 7½ wide (shown above fig. 1), but being plastered over it did not appear on the surface of the vault. The oak is perforated with a trefoil cutting, 6 inches from point to point. The perforations, if not so intended originally, seem, when the plaster with a fine polished surface was applied for the painter, to have afforded a key or holding for the plaster. Without the plaster there would have been five rows of ornamental perforations. It should be observed of the painted decorations on the vault, that they are from Old and New Testament history, arranged in five rows corresponding to the urns, although the latter were entirely lost sight of beneath the colour and plaster.

Of examples produced by French authors of the urns built into walls, one naturally begins with that of the church of the Célestins of Metz. I conceive that Mons. Didron would certainly have quoted M. Bouteiller, if the latter, in his memorials of the church, had been able to say that any fragment or mark of the pots put up by Ode-le-Roy had been discovered at the final destruction of the buildings.* No such quotation being made, I am left with the few descriptive particulars furnished by the chronicle. From this I gather that the pots were made for the occasion, that they were applied to the walls of the church on an extensive scale, so as greatly to disorder them, and notch them about; that nevertheless a competent number of workmen being got together, all the pots were fixed in one day; that they had so much of permanence about their fixing, that they remained when the chronicle was written at least thirty-six years after, but that they were deemed useless for any acoustic purpose, and their appearance was the jest or wonder of beholders. Of the other church, where Ode-le-Roy had seen similar urns, or of its locality, I have no particulars whatever.

In April, 1842, at the church of St. Blaise at Arles, was made the first French modern discovery of earthenware pots built into the walls. Mons. Didron had the matter communicated to him by Mons. Huard, director of the Museum of Arles, and published a notice of it in the *Bulletin Archéologique*, of 15th January, 1843, vol. II, p. 440, which notice he repeated in the *Annales Archéologiques* for 1862, p. 295. Mons. Didron calls the pots discovered at Arles†

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* In a footnote to page 72 of M. Ernest Bouteiller's *Notice sur le Couvent des Célestins de Metz*, it is stated that the officer in charge of the works of demolition had been struck by the existence of these pots, the use of which he could not account-for. The footnote is thus worded : " Lors de l'appropriation de l'église à sa destination dernière, M. le Commandant Soleirol, chargé de la direction des travaux, avait été frappé de l'existence de ces poteries, de l'utilité desquelles, peut-être, il n'avait pas pu se rendre compte. L'explication en est donnée de la manière la plus complète."

† See Appendix B for an extract from Didron's notice, and for other extracts relating to mediæval examples.

"cornets" of baked earth, and "pots acoustiques." They were placed in a hollow of about 21 centimetres diameter (7 to 8 inches) in the thickness of the wall, and on the inside of the church, at a height of 6 or 7 metres, at regulated distances from each other, but at what distances does not appear. They were in the first bay of the church in advance of its older portion: but having no acquaintance with the building, whether this was in the nave or choir, I could not understand. The form of the pots is that of a "marmite," with a narrowed neck, the mouth being only about 1¼ inches diameter at the outlet, and scarcely 2 inches at its inner end, joining the body of the pot. Two little holes pierced in a boss on the length of the cornet served to attach a suspending cord. Mons. Didron adds that these cornets are altogether like those still used in some of the French provinces by the herdsmen, or like those which are heard to resound in the streets of Paris at the time of the carnival. The part of the church of St. Blaise, where they were found, was built in 1280, though it is not clear that this fact throws much light on the age of the cornets.* I have myself applied by letter to the Director of the Museum at Arles, but have failed to obtain any further particulars of these vases.

The Abbé Cochet published his experiences of Acoustic Property first in 1852, in *Les Églises de l'Arrondissement d'Yvetot,* relating to the Church of Alvimare, Canton of Fauville, and the Church of Mont-aux-Malades, near Rouen, and afterwards communicated the like information to the *Annales Archéologiques* in 1862, and to *The Gentleman's Magazine* for November, 1863.† The Church of Alvimare had been destroyed since his observations upon it were made, but his description in his own English, which is a very literal rendering of his French, is that he saw eight circular holes in the prisms which surrounded the pillars of the choir, and which were the openings of earthen vases placed in the wall for acoustic objects and as agents of repercussion. The number of the holes is supplied from the French description. The exact meaning of some part of this meagre description must be conjectural, viz., as to the prisms. My conjecture is that it was intended to indicate the solid faces of the pillars projecting between and forming the nooks or recesses for slender attached shafts. In the Church of Mont-aux-Malades, the Abbé says similar vases fill the windows of the nave and choir. How they can *fill the windows* without reducing the church to darkness it is difficult to imagine: but this seems to be a superfluity of his English description, as the French only conveys that they are in the windows. Perhaps they filled the width, in a course at the bottom along the inside sill. The vases were found in 1842 in restoring the "pilasters" of 12th-century work, and he thinks the vases belong to an acoustic operation of the 17th century. Neither at Alvimare nor Mont-aux-Malades do we get any further description of the vases, but in the absence of any date given to those at Alvimare, and in their similarity to those at Mont-aux-Malades, we may assume, that the Abbé thought them also of the 17th century. The Abbé Cochet had seen "Acoustic Vases" in the Church of Perruel (Eure), and in the Church of Contremoulins, near Fécamp, but he gives no particulars about them.

In 1862 the old Church of St. Laurent-en-Caux, Canton of Doudeville, was pulled down. One vase was found (see Illustration No. 2, fig. 2). The Abbé Cochet published his notice of it, with the two others following, in *The Gentleman's Magazine* for November 1863, with very satisfactory sketches of them. This one of St. Laurent-en-Caux was in one of the angles of the

* In Mr. Cuming's Paper, before referred-to, this is mentioned as an example of constructive pottery. Mons. Didron did not understand it in that light.—G. M. H.

† See Appendix B.

choir, entirely enveloped in mortar. His own English description is: "The form was that of a cone closed at each end. It had no other opening but a beak, which appeared in the form of a cornet at the surface of the wall. The exterior was furrowed with horizontal grooves." The Abbé had seen such peculiarities of fabrication (the grooving I suppose is referred-to) on vases of the 13th century found at Leure, in the tomb of Pierre Berenguer in 1856. This vase he thinks (Ecce risu digna) well suited to acoustic purposes, and unsuited to any other. The length of the vase is about 12½ inches.

The next example given by the Abbé Cochet is from the vaulting of the tower, forming part of the choir (see Illustration No. 2, fig. 3), of the Monastery of Montivilliers, which was a work of the year 1648,—he thinks the vase of that date; it was removed to the library of the city of Montivilliers for preservation. In a notice of it which he sent to the *Annales Archéologiques* in 1862, the size of the vase is more fully described than in his English account. The length is 34 centimetres, or just about 13 inches. The circumferences are 18 centimetres in the lower part, 46 centimetres in the middle, and 54 centimetres at the largest part. The mouth is 6 centimetres in diameter. The mouth which is at one end has a "neck moulding." The material is of an ash grey colour. He had noticed a dozen acoustic holes in the four angles of the clock tower of which the vault was ruined in the 17th century; a somewhat vague remark which it is difficult to connect with the preceding description. Viollet-le-Duc says of similar "poteries" at Montréale that they were "noyées dans les reins des voûtes."

The final instance to be adduced from the Abbé Cochet is that of two vases (see Illustration No. 2, fig. 4) found in 1858 in the choir of the Church of Fry, Canton of Argueil, and two similar found in the sacristry of that church. They are 12 inches high with a narrow neck and a handle. He thinks them culinary vases of the 16th century put to a monumental use. He gives no particulars of their position or fixing in the walls.

In December, 1863, the Rev. Mackenzie Walcott, in a brief note to *The Gentleman's Magazine*, adds three French churches to the list of those where acoustic pottery has been found, viz., at Aberbrach in Brittany, at St. Martin, Angers,* and at Clisson. I have not, however, any details relating to these. I applied to the late Mr. Mackenzie Walcott for further information as to these, but I learned that he could add nothing to their names.

Viollet-le-Duc in his *Dictionnaire* (Art. "Pot") adds to those already given two instances in France, viz., in the square apse of the Church of Montréale (Yonne), and in the Church of Perruel near Périers-sur-Andelle (Arrondissement of Andelys, Eure), but without particulars of the pots or their arrangement. He remarks however that he has frequently seen the "acoustic pots" in the choirs of churches of the 12th and 13th centuries, usually set in the masonry and showing only their orifice in the surface of the wall. They were placed at different heights, but particularly near the angles, and at times in quincunx,—a gardener's term for four trees planted at the angles of a square with one in the middle.†

In Switzerland it is said that numerous existing examples of acoustic pottery in church walls are known. In 1871, the Rev. G. W. W. Minns in publishing a short article on

* See Appendix B for an extract from a letter by the late Dr. Bromet, addressed to the Hon. Secretary, in 1847, (also quoted in the TRANSACTIONS, 1860-61, p. 85) respecting the vases found at this church. A diagram of one, taken from a sketch preserved in the Library of the Institute, is also given.

† One of my correspondents, Mr. J. S. Amery, asks—have I seen the jars in the Museum at Rouen? I have not, but it is worth while to direct the attention of others to them.—G. M. H.

"Acoustic Pottery," gave a communication on the subject of Swiss examples which he had then just received from the well-known antiquary, Mr. Albert Way, F.S.A. In July, 1871, Mr. Way having requested Dr. Ferdinand Keller, President of the Society of Antiquaries of Zurich, to show him "one of the churches in which such vases occur," he was enabled to inspect one where the discovery of their existence had been first made in 1868. "They are in the choir of a church of a nunnery, XIII cent., now desecrated. The form of the pots is like those found at St. Peter-Mancroft (see Illustration No. 2, figs. 9 and 10), made of very hard clay 9″ × 7.″ They are placed on the higher part of the walls in two rows about 3 feet apart, and the rows also about the same distance. There are about sixty of the pots still remaining. The building was narrow and very lofty. I could hear of no signs of pots in any part of the building nearer the floor. The pots extended only along the portion of the east end that formed the choir, not in the nave. There are no transepts or side aisles. Dr. Keller has had a survey taken and drawings of the forms of the pots, they all seemed alike."

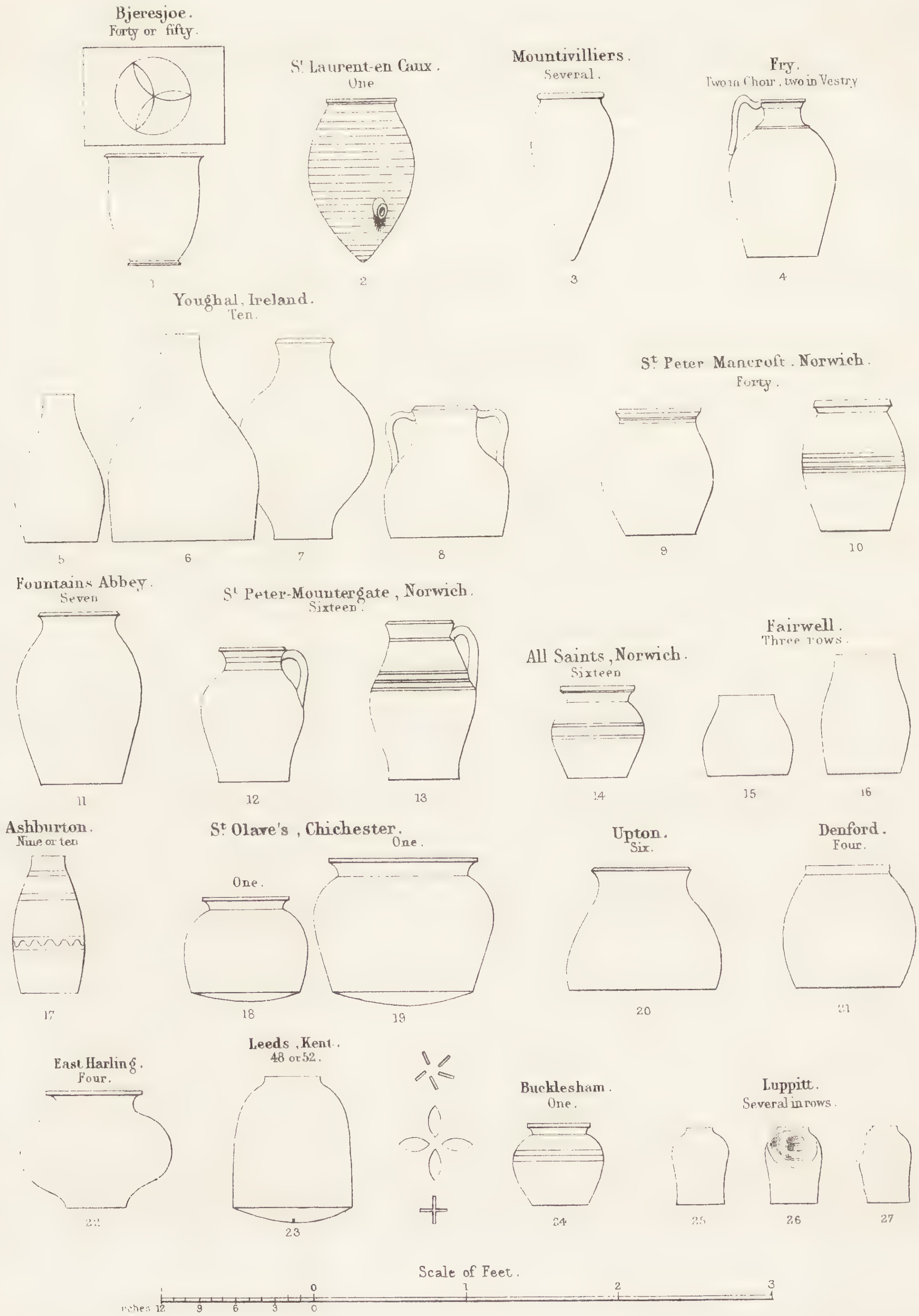
In Ireland one instance has occurred. The Irish discovery was at the fine ancient Collegiate Church of St. Mary, Youghal, and was reported in the Kilkenny Archæological Journal for 1854-55, and again by Mr. R. R. Brash, whom I have previously mentioned, in *The Gentleman's Magazine* for December, 1863. It is a cruciform church with aisles to the nave and to one transept, and none to the chancel. The nave is 114 feet by 30 feet, and the aisles 13 feet wide. The transepts are 109 feet from north to south. The chancel is 68 feet by 26½ feet. In hacking off the inside plaster of the north chancel wall at 25 feet from the ground, five orifices 3 inches to 6 inches diameter were found, each in a piece of freestone; behind each was an earthenware jar with its mouth to the vent—all were lying sideways embedded in the masonry at irregular distances apart; some were glazed, some unglazed, all perfectly empty. Subsequently Mr. Brash says, five similar jars but of smaller size *(sic)* were discovered in the same position on the opposite side of the chancel. Figs. 5, 6, 7, 8 in Illustration No. 2, give the forms of four out of the five northern jars, as various in dimension as in shape. All were taken out, examined and replaced, and shortly afterwards the chancel, which I saw a picturesque ruin in 1852, was roofed-in and restored to use. The chancel is of the 14th or 15th century.

The earliest notice of the discovery of pottery built into church walls in England occurred in 1771 in relation to a church at Fairwell in Staffordshire. I pass it over for the present in order to come to the next discovery, viz.: at St. Nicholas Church, Ipswich. This was the first of a series of discoveries which followed in a few years, of vases embedded in walls, underneath the floors of the choir seats. Fig. 5, in Illustration No. 1, is a typical plan not drawn from any one discovery, but intended to show the disposition given to the vases in these cases.

The discovery at St. Nicholas Church, Ipswich, was made about 1848 or 1849 whilst some repairs were in progress, which are the subject of remark in the Journal of the Archæological Institute, vol. VI. (for 1849), p. 76. In the volume for 1855 (p. 276) the jars themselves are very briefly noticed in a communication from the late Mr. C. C. Nelson, formerly an Honorary Secretary of this Institute, who describes vestiges of the side walls of a passage under the chancel floor, which I have no doubt was in fact the space between the sleeper walls upon which the wood floor of the chancel stalls rested. In these side walls were embedded one-handled jars or pitchers. The nature of the passage is said to be similar to the instance

TRANSACTIONS OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS, 1881-1882.

EARTHENWARE POTS (BUILT INTO CHURCHES) WHICH HAVE BEEN CALLED ACOUSTIC VASES (No. 2)



G. M. Hills, delt. J. P. & W. R. Emslie, lith.

hereafter noticed at Fountains Abbey. In past years and in the autumn of the present year, by friends and by personal inquiry, I have sought in vain for further particulars of the discovery at St. Nicholas, Ipswich. At the church nothing whatever is now known or recorded of it. At the Ipswich Museum no relic of this, or of the discoveries at the other Ipswich churches, is preserved.

The next discovery was at the chancel of the church of St. Peter-Mancroft, at Norwich, during restorations carried out in 1852.* Mr. S. W. Tracy submitted an account of the discovery of the jars, with drawings, to this Institute, and from this Mr. C. C. Nelson gives a description in the Archæological Institute Journal for 1855. Remains of passages had been found under the chancel floor having earthen jars embedded in the side walls. These vessels of red ware with a slight glaze on the upper part, were laid horizontally about 4 feet apart, their mouths being flush with the face of the wall; they measure 8 inches in height, the diameter of the mouth being about 6 inches ; one of the jars was shown to the meeting. No opinion as to the intention of the arrangement was elicited,—but the similarity to that at Fountain's Abbey was noticed. The fuller account given in *The Builder* by Mr. Phipson with an engraving, describes the so-called passages as drains 2 feet wide and 2½ feet deep, floored with concrete and the walls of the passages roughly plastered. These drains or passages were under the chancel stalls along both sides of the chancel, and also under the transverse return of the stalls at the west end of the chancel; the pots were built into both walls of each passage, their mouths turned to open into it. They were forty in number, and about 3 feet apart from centre to centre. The arrangement of the walls Mr. Phipson says exactly followed the usual arrangement of choir seats. The size of the jars varied a little but they were described as 9½ inches high, 6 inches diameter at the mouth, and 8 inches diameter at the largest part (see Illustration No. 2, figs. 9 and 10), and having a variety among them, some with and some without the banding lines. The only covering over the space into which the jars opened was an old wood floor and joisting. They were free from any kind of deposit. Mr. Phipson, who was the architect employed on this restoration, thinks the whole arrangement and the wood floor were coeval with the church, which was finished and consecrated in 1455.

The discovery at Fountains Abbey in Yorkshire was made in the early part of 1854. It is reported in the TRANSACTIONS, 1853-54, in letters from Mr. Harrison, of Ripon, to Earl de Grey ; also in a communication by the well known antiquary, Mr. J. R. Walbran, F.S.A., of Ripon, to the Transactions of the Yorkshire Architectural Society for 1854-55, and in *The Builder* for 1854, pp. 342, 343. I have myself examined this discovery, and it was my business to describe it as it existed at the visit of the British Archæological Association to Fountains Abbey in 1863. That description I now extract from the second volume of the *Collectanea Archæologica*, page 294. " In the latest arrangement of the choir, which included only two bays of the nave, one of these seems to have been wholly occupied with the screen or jube dividing the choir from the nave, so that the foundations for the choir stalls, which were discovered in 1854, are on the east side of this screen, just within the first bay. These foundations, or sleeper walls, have excited a great deal of comment, without producing any satisfactory explanation of their peculiarities. Two parallel walls, 4 feet 3 inches apart, the foundations of the transverse stalls, extend across the floor of the

* Mr. R. M. Phipson, of Norwich, one of our Fellows, gives the date of this discovery as 1850 in a communication to *The Builder* of 1863, p. 893, and gives further particulars in *The Builder* for 1864, p. 35.—G. M. H.

nave, forming a trench about 18 inches deep, discontinued for about 7 feet in the middle of the nave for a central doorway from the nave into the choir, the trench turns eastward, reduced to 3 feet wide, against the screen walls of the side arches of the bay for a length of 4 to 5 feet, where it is broken off and destroyed, but no doubt it went much further; in fact, when perfect, the foundation of the side stalls probably continued eastward as far as the east side of the central tower. These trenches are roughly paved with stone, and the mystery is that the north trench had in its back wall (when it was opened in 1854), and forming part of its regular structure, seven earthenware jars, of about 2 gallons each, laid on their sides, with their large mouths open into the trench; three of these jars in the longitudinal part of the trench, and four in the transverse part. One of the jars was taken up and sent to London; it is now in the Abbey Museum. The other six remain *in situ*." The earlier notices of the discovery increase the number of jars from seven to nine. The jars are of rough earthenware, varying from 12 to 14 inches in height, 6 to 7 inches diameter at the base and mouth, swelling between to 10 inches diameter (see Illustration No. 2, fig. 11). The trench, where the jars were, contained much charcoal, which also partly filled the jars. Both Mr. Walbran and Mr. Harrison, who were constantly on the spot at the time of the discovery, hesitate to connect this with the use of the jars; (I hesitated in the same degree) and they suggest that amongst other causes that could be thought of in connection with the ruining of the church, accounting for the presence of an abundance of charcoal or wood cinders, one might be the melting for sale, or after sale of the lead of the roofs,* which, as is known, was melted on the spot.†

In 1860 the small church of St. Peter-Mountergate, at Norwich, was under repair, the architect employed being Mr. William Bassett-Smith. His plan of the church is given in Illustration No. 1. He called my attention at the time to the discovery of jars under the wooden floor where the chancel stalls had been. A notice of the discovery by Mr. Phipson, who has obligingly revized and enlarged that account for me, was published in *The Builder* for 1863, p. 893. He says the plan of the "drain," allowing for the smaller size of this chancel, corresponded with that of St. Peter Mancroft, and like it, was merely covered by an old wood floor. The church being smaller the jars here were fewer, viz. eight to each space or set of stalls, and they were not opposite each other, but placed in one wall only, viz. the inner wall, with their mouths open towards the outer walls of the spaces. Moreover these all had handles. They are 9 to 12 inches high (see Illustration No. 2, figs. 12 and 13) and 7 inches wide at the greatest diameter, the mouths 4 inches to 4½ wide, some were partially glazed inside; all were free from any deposit. Engravings of them are given in a Paper by the Rev. G. W. W. Minns. Two of them are preserved in the Norwich Museum. (See vol. VII, 1872, Norfolk Archæology).

Again, in *The Builder* for 1866, p. 392, Mr. Phipson reports another discovery at Norwich of jars found in a corresponding position and arrangement under the chancel floor of All Saints Church, with, however, this material difference, that here the outer rows of jars were built into the base of the main wall of the chancel, which is of the 15th century, instead of into a mere sleeper wall for the joisting. This left the trench 2 feet 4 inches wide. It was 15 inches deep. The jars were 16 in number, 4½ feet apart from centre to centre; their size 7 inches

* See also Walbran's *Guide to Fountains Abbey*, p. 77; and his *Memorials of Fountains Abbey*.—G.M.H.

† See Appendix B for references to the discovery at Fountains Abbey.

high, and 7½ diameter at the greatest part (see Illustration No. 2, fig. 14); they were glazed inside. This discovery was made in the early part of 1866, during a restoration of the chancel, conducted by Mr. W. Bassett-Smith beforenamed. The Rev. G. W. W. Minns says, that since 1865, and before 1871, a discovery of acoustic jars has been made in the church of St. John-de-Sepulchre, Norwich. I have failed to obtain further particulars.

I now go back in date of the discoveries to give the instances of pottery built into the higher parts of the walls, commencing with the Staffordshire example before alluded-to.

The earliest notice of such jars found in England is in *The Gentleman's Magazine* for 1771, page 59, in a letter from Lichfield, dated 27th January, 1771. It mentions that in taking down to rebuild the church of Fairwell, near Lichfield, urns were discovered built into the south wall; they were laid on the side with their mouths directed to the inside of the church, and their openings were slightly plastered over. The number of the urns is not given. The arrangement of them is something like the Swiss example, given by Mr. Albert Way, in the church of a nunnery. Fairwell Church was also the church of a Benedictine nunnery. At Fairwell the urns were in three rows, the lowest row about 6 feet above the floor. A drawing of one of them is given, and they are said to be similar in form, but varying in size, so that the smallest would hold about 1 quart, and the largest 2 quarts. In the modern edition of the *Monasticon* it is added that the smaller urns were 6¼ inches high, 4½ inches diameter at the mouth, and that they had a circumference of 24 inches (see Illustration No. 2, figs. 15 and 16). It is also stated that the rows were "several feet" between, and the urns "some feet" apart. Three were preserved. Shaw's *History and Antiquities of Staffordshire*, vol. I, p. 229, is referred to by the *Monasticon* as the authority for these particulars, and as giving a view of the church in ruins in 1744. The discovery of the urns is said to have been made in 1747.

An instance which has much resemblance to the arrangements at Fairwell was discovered in 1838 at the parish church of St. Andrew, Ashburton, Devonshire. For information respecting it I am indebted to several local correspondents, chiefly to Mr. G. Pycroft of Kenton and to Mr. J. S. Amery of Druid, Ashburton. A description is printed in the Proceedings of the Society of Antiquaries of London for January, 1873, and in the Transactions for 1873 of the Devonshire Associations for the Advancement of Science, Art and Literature. From these it appears that in 1838 the jars were found in the inside of the chancel walls when the old plaster was then removed. The jars lay on their sides firmly fixed in mortar, each in its own recess, and the mouth directed to the inside of the church, but closed with a piece of slate, and buried behind the plaster. Several were taken out, and all were found empty. Between 1836 and 1840 the chancel was entirely remodelled, and then and subsequently no attention was paid to the discovery beyond the locality till 1872. In that year Lieut. Worthy of the 82nd Regiment made it public by communications to the Society of Antiquaries and to Mr. Winter Jones of the British Museum. These have been printed as above stated. Mr. Worthy found that from the alterations made to the chancel in 1836-40 he was unable to give an opinion as to the age of the walls in which the jars were found; but the probability seems to be that they were of the 15th century. From a workman employed upon the alterations he ascertained that there were nine or ten jars found besides the one he saw and drew, that the holes in which they lay were like those which are left in walls for the reception

of scaffolding, that they were not regularly placed one above another, but the workman said "were scattered all over the north and south walls of the chancel on their interior sides." I judge from these descriptions that the jars were really laid in the putlog holes of the scaffolds, which would bring the jars into horizontal rows without the jars being vertically over one another. Mr. Worthy furnished a drawing of one of the jars, and from the woodcut of it, fig. 17 in Illustration No. 2 is taken. He describes it as of a red ware like common flower pots, and having a zig-zag ornament round the body, with a very faint white mark under it. Two of the jars are still preserved in the possession of a gentleman in the neighbourhood. One of them was exhibited at the Society of Antiquaries in 1873. I did not see it there, and I have not succeeded in obtaining the favour of a sight of them now.

At the little church of St. Olave in Chichester, in the course of a restoration in 1851, two earthenware pots were found built into the east end wall of the chancel, one on each side of the upper part above the east window. They were exhibited at the Congress of the Archæological Institute in Chichester, and described in the Sussex Archæological Volume, for 1854, page 296; one is 8 inches diameter at the mouth, and 10½ diameter at the greatest, its heighth 8½ inches, the other is much larger, 14 or 15 inches diameter, but much broken when found, and 11 inches high. At the bottom they were not flat, but slightly convex. This form, it was thought, adapted them for cooking pots to stand in hot ashes. There is a good deal of Roman material used in the construction of this little church, and at the first discovery of the urns this circumstance led the Rev. P. Freeman (afterwards Archdeacon of Taunton) to describe them at p. 223, vol. V, of the Sussex Archæological Collections, as Roman, a description which, as he afterwards told me, he gave with much distrust as a novice in such matters, and which others have positively dissented from. The jars were placed on their sides, the mouths facing inwards to the church. They are now in the museum at Chichester. The Rev. A. Fuller, by whose help I am enabled to draw them to scale (see Illustration No. 2, figs. 18 and 19); of the larger only a portion remains, viz. two considerable fragments. This little chancel is 16 feet 6 inches long, by 12 feet 6 inches wide, and was built with a crypt or undercroft. The east window was of the 14th century, and the fixing of the vases was not earlier, but the lower part of the wall is Norman. The nave is only 25 feet long by 18 feet wide, and there is no tower.

In *The Gentleman's Magazine* for December, 1863, in a short letter signed "J. S.," it is reported that at Upton Church, near Southwell, Notts., in the summer of that year three vases were found built into the wall on each side of the chancel, at 7 or 8 feet from the floor. They had been plastered over. They were 6 feet apart, and their mouths facing the inside of the chancel. A sketch of one is given in Illustration No. 2, fig. 20. The height is 9½ inches, the diameter at the bottom 11½ inches, at the neck or mouth 8¼ inches.

In 1864, in the chancel of Denford Church, Northamptonshire, remains of jars were discovered embedded in the north wall, about 8 feet above the pavement, just above an arcade of 13th century arches, like sedilia. It is suggested by the architects, Messrs. Wadmore and Baker, who were employed on the restoration in progress, that probably a similar arrangement had existed over the corresponding sedilia in the south wall, but had been destroyed in the insertion of a window there of a later date than the arcades. The jars on the north side had been broken into, damaged and roughly put out of sight again about A.D. 1849, so that only

one was now found perfect, and the forms of the others were left imprinted in the mortar. The discovery is reported in *The Builder* of December, 1864. A woodcut given shows that they were four in number. In the internal stone facing of the wall four little openings were formed, one of them circular (towards the west), and the other three semicircular, the openings being regularly arched with little stone voussoirs, the eastern vent a little below the level of the others. Within the openings were the mouths of the jars, which are represented laid on the side. Their greatest diameter is 10½ or 11 inches, the mouth is 6½ inches diameter, and the bottom 9 inches, the height 9½ inches (see Illustration No. 2, fig. 21).

In 1869, at Sandwich in Kent, in St. Clement's Church, whilst undergoing restoration under the direction of Mr. Joseph Clarke, F.S.A., three pots were found in the chancel walls, all at about two-thirds of the height of the wall above the pavement. They remain now as they were found. Two are in the north wall, about half way along the chancel, one in the south wall near the east end; the pots are filled with mortar, and being laid sideways present their mouths to the inside of the church. They measure about 1 foot in the opening, and have a brim of an inch wide.

At East Harling Church, Norfolk, in July, 1872, four vases were discovered in the chancel. The discovery is reported at p. 306 of the volume of the British Archæological Journal for 1873, through the Vice-President, Mr. H. S. Cuming. I avail myself of the account there given to Mr. Cuming by Mr. H. Watling, of East Stonham, who was present immediately after the discovery, and sketched them in position, and also of some corrections to that notice with which Mr. Watling has favoured me. The jars were four in number, ranged at the top of the north wall of the chancel, above (not *beneath*, as printed) the wall-plate of the roof. They were laid on their sides, presenting their mouths to the inside of the chancel, 2 ft. below an upper plate or cornice, which formed a line at the top of the upright timbers technically called "ashlars or droprafters," and at the bottom of the sloping ceiling formed on the rafters. The jars were placed, at almost equal distances occupying the length of the chancel, between the "ashlars" in an open cavity backed by solid walling 9 in. behind the face of the wall; upon this backing the bottom or back of the jars rested. The spaces between the ashlars had been closed up by lath and plaster which being removed for repairs to the roof, the jars were disclosed to view. A sketch of the chancel sent to me by Mr. Watling shows it to be of the fifteenth century. It is well preserved, having a fine east window, with the original stained glass. The church is a large one. The four vases are alike in shape and size. They are about 9 in. in height, and the diameter at the mouth is 6 in. Their height from the floor is about 20 ft. Mr. Cuming, judging them from form and material, considers them to be of Romano-British manufacture of the fourth or fifth century (see Illustration No. 2, fig. 22).

Besides these examples, Mr. Phipson informs me that three jars were found (about the year 1850) at St. Clement's Church, Ipswich, built into the foundations of the main walls of the chancel, with their mouths inwards. These Mr. Phipson did not himself see. I have made full inquiry at the church, particularly of the old clerk or sexton, who has known it for 60 years, who thinks there is no foundation for the report. Moreover, the chancel is wholly modern, built 12 years ago, and although there must have been an ancient chancel, no part of it remained, nor was any remnant found in laying the foundations of the new work. So also at the church of St. Mary-Tower Mr. Phipson heard of the discovery of a single jar, since found

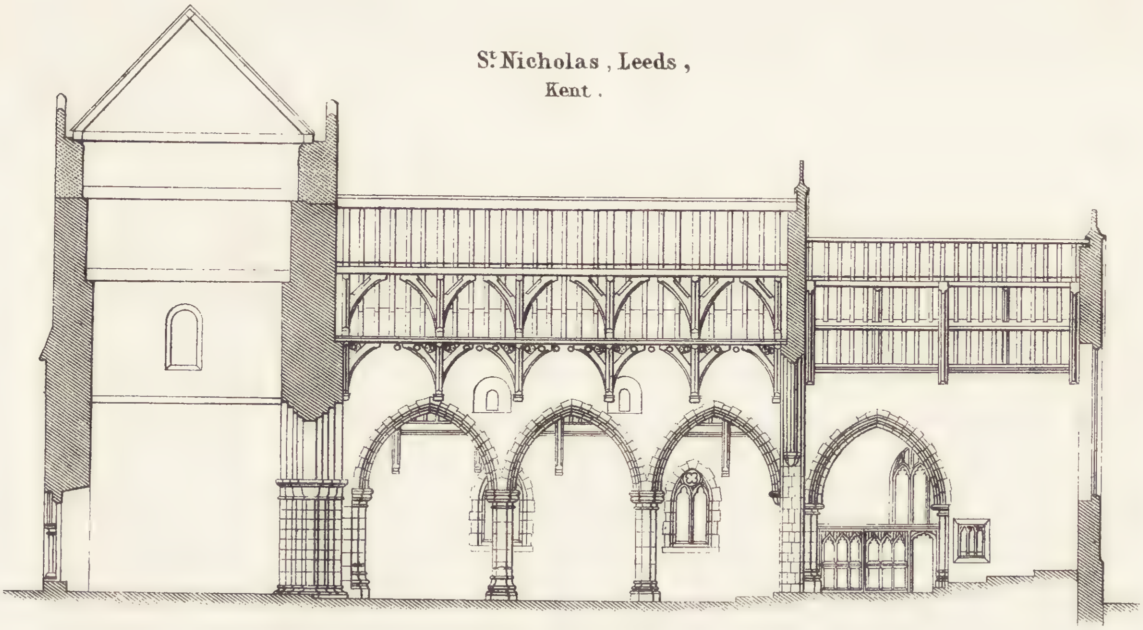
built high up in the chancel wall, the mouth of it directed inwards, and covered with a perforated stone, with openings (as shown in Illustration No. 1, fig. 4), but the jar was destroyed before he could see it. From Mr. W. G. Cunnold, of Ipswich, I also hear of an urn found by him at Bucklesham Church, Suffolk. It was in the side wall, built into brickwork, or bricked up in the wall in a niche, and was within the chancel-rails, 3 ft. above the floor. The urn is given in Illustration No. 2, fig. 24. Mr. J. E. K. Cutts, in a communication to *Notes and Queries*, May 21st, 1881, says that fifteen years ago there were three supposed Roman urns to be seen built into the east gable in the south aisle of Newington Church, Kent.

Whilst these sheets were in type information reached me of an interesting discovery made in the year 1880 at Luppitt Church, near Honiton, Devon. I am indebted to Mr. J. H. Spencer, architect, of Taunton, and to the Rev. W. T. Perrott, of Luppitt, for a description of the discovery, and for a sight of one of the jars. From this one, figs. 25, 26, 27, in Illustration No. 2, are drawn. Mr. Spencer had sent to *The Builder* in June, 1880, a notice of the discovery. In the course of some restorations then proceeding at the church, under his superintendence, when the plaster had been removed from the inside of the north and east walls of the chancel, the original putlog holes were found going through the entire thickness of the walls, the openings on the interior face being stopped with a small vase of rude pottery fitted into each. The mouths of the vases were turned to the inside of the church, and immediately behind the wall plaster. Mr. Spencer thinks the walls 13th-century work, but windows of the 15th century have been inserted in them. The absence of any one of authority at the moment of the discovery, and the eagerness of the workmen to get out the jars as they disclosed them, led to several being destroyed, and to uncertainty as to the actual number; three or four are spoken of as now in existence, and six or eight as having been seen. All were similar in their characteristics, and these are very remarkable. The one I have before me is six inches high, and four and a half inches across at its greatest diameter. It is the smallest example I have met with. It was evidently made for the purpose to which it was applied, for to enable it to rest the better on its side the side is flattened in one part. Fig. 25 shows the full outline of the jar as presented looking at its upper side; fig. 27 gives the profile of the under and upper sides; fig. 26 is a view of the depression in the under side. This depression was evidently made whilst the clay was damp and soft, after the pot had been turned on the wheel, by pressing it with the fore-knuckles of the three first fingers of the right hand, whose impression is very distinct, and exactly fits my own fingers. The material is well burnt, the exterior a greyish red, and where broken the interior is seen a grey black.

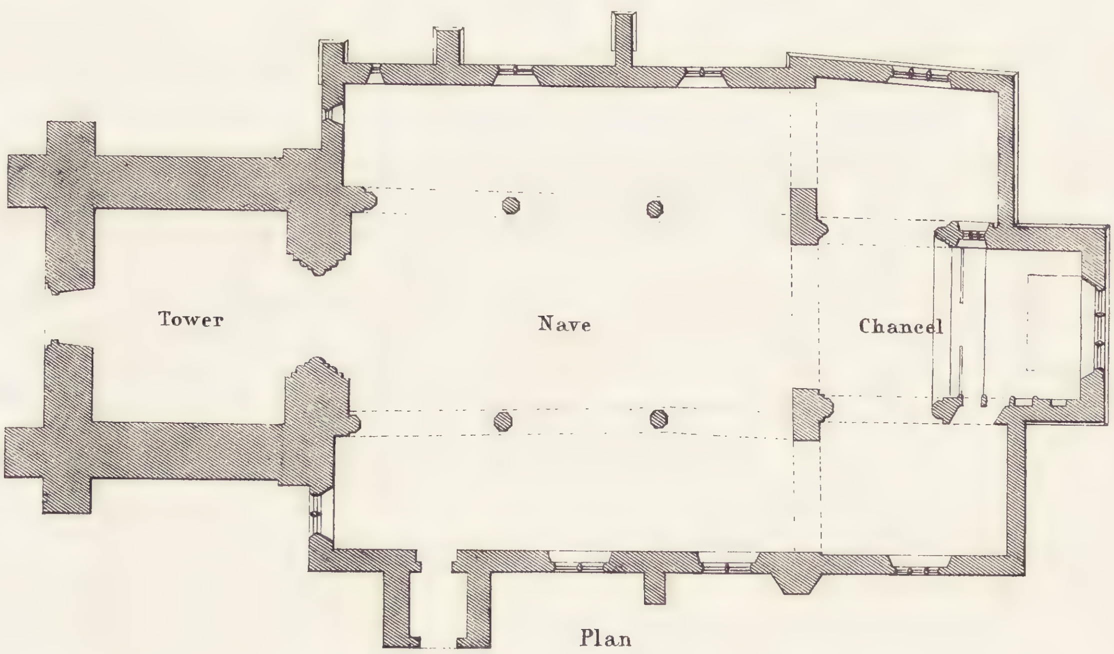
I come now to the most important and to what I had thought to call the most recent discovery, viz., that at Leeds Church, near Maidstone, Kent. In August, 1878, upon removing the nave-roof, a range of earthenware pots was found extending the whole length and embedded in the top of the nave wall on both sides of the church. There were certainly twenty-four, and I think it probable twenty-six, on each wall, making forty-eight to fifty-two in all. Some of them had become broken up and their matrices in the wall dislocated, so that I was not quite confident in counting to the higher number; but the spacing of them would give that. In the middle bay five jars, the next bays on each side of it five each, the next bays three or four each, and one at the side of each of the extreme tiebeams next each end wall. They were

EARTHENWARE POTS (BUILT INTO CHURCHES) WHICH HAVE BEEN CALLED ACOUSTIC VASES (No. 3)

St. Nicholas, Leeds, Kent.



Longitudinal Section showing position of pots.



Plan

Scale of Feet.
10 5 0 10 20 30 40 50 60

G.M.Hills, del.

J.P.&W.R.Emslie, lith.

laid on the side, their mouths facing the centre of the nave and straight with the face of the wall, but their mouths had been plastered over. Their height from the floor was 28 ft. (see plan and section of the church, in Illustration No. 3.) The walls are of the fifteenth century, and the oak roof upon them, which had become very ruinous, was of the same age, or would be so pronounced but for some very minute particulars, which I will try to explain. Under each tie-beam an upright timber came down the face of the wall, resting at the foot on a corbel. These uprights divided the length of the wall into five bays or spaces, and upon the face of the wall, in the spaces, arched timber braces sprang from the feet of the uprights, going up to the cornice or wall-plate in the centre of each bay, forming a sort of arcade of timber of five arches along the top of the nave walls on each side of the church. Now, the plaster on the walls extended all behind these timbers, which suggests that, although the roof and the walls look, by their architecture, so nearly alike in age, yet the timber arcading was not originally a part of the roof, yet the inner wall-plate and cornice of the roof so greatly overhung the face of the wall that the support of the arch timbers was necessary to its stability. Immediately below the line of this wall-plate the pots were disposed, and so spaced as to avoid the tie-beams. About one hundred years ago the roof timbers near the top of the walls had become so decayed that, to keep them in place, rough masonry was then built up on the top of the fifteenth-century walls and jars to a height of 3 or 4 feet, embedding in it all the roof timbers; at the same time the timber arcades, having perished to an unsightly state, were lathed and plastered over and made into a plaster arcading. This of course completely shut the mouths of the jars off from the church, though they could scarcely have been at any time perceptible behind the timber-work. A local archæologist advised the removal of the jars to the Maidstone Museum, and accordingly nineteen were sent there, three only and a few fragments being preserved on the spot. The opinion of several experts as to the age of the pottery was taken when one of these jars and fragments of others were submitted for inspection at a meeting of the British Archæological Association, December 4th, 1878. Mr. Syer Cuming, F.S.A., Scot., was then reported to have thought these jars of great antiquity. I take this opportunity to correct that report. Mr. Cuming authorizes me to say that there is nothing in the make of the jars which does not admit of their being of the 15th or 16th century, that is to say, of the time to which I attribute their being placed here. The jars vary but little in form and size (see Illustration No. 2, fig. 23), being 11 in. to 12 in. in height, their mouths 4½ in. to 5 in. in diameter, and the body 8½ in. to 9¼ in. in diameter. They resemble the jars discovered at St. Olave's, Chichester, in having the bottom convex, but they differ from all others in having it also perforated, so that they never could have been intended to hold liquid. The greater number have the bottom perforated with a simple cross, about 2½ in. over; two have a large quatrefoil perforation (see at fig. 23), and one has an irregular star of five rays. It is difficult to assign any purpose to these vases, so placed, except a belief that they would affect sound. But there is an additional arrangement intended, it would seem to assist this effect, or to extend it into the aisles. The two nave walls are each carried by a fine "Perpendicular" arcade of three arches, and the north wall has two semicircular headed recesses in the spandrels of these arches, visible only from the north aisle. They are left now in the same condition which they presented before the recent restorations. The first idea suggested by their appearance was, that they were remains of two very small semicircular headed clerestory windows of pre-Norman date. There are several windows and

considerable remains of walling of that date on the tower and outer walls of the church. After we had cleaned the old plaster off from the walls it was found that these recesses were in fact openings through the walls, and that there are two in the south wall of the nave corresponding to them, all four being alike. They are formed in a very peculiar manner. In the middle of the wall an oak board, 1½ to 2 inches thick, is placed upright, and perforated with a semicircular headed opening, 12 to 15 inches wide, and 27 inches high; the edges of the board are roughly splayed on each side; from the opening in this board, the wall is splayed equally on both sides through its thickness (see Illustration No. 1, fig. 3) forming jambs, and the splays are carried over the top forming semicircular splayed arches; roughly done in rubble stone, there being no dressed masonry about them. By these splays the opening is enlarged at each face of the wall to a width of about 4 feet. In one of them I caused the wood frame to be entirely laid bare, though afterwards covered up again. The stone of these openings is not of the "tufa," of which all the other pre-Norman windows and early walling of the church consists. To me they appear to be "sound holes" (see Illustration No. 1, fig. 3). The timber arcading along the nave encroaches on one of them, which suggests that it was applied not only to the roof after an interval of time, but after the contrivance of the sound-holes, and therefore after that of the jars—whilst also the unarchitectural character of the sound-holes suggests that they were hastily made, much in the same way as the contrivances of the Prior of the Célestins at Metz. In the south nave wall the two openings were and are still solidly walled up. It is worth while to notice that between the chancel and its north chantry is a hagiocope shown in the section of Leeds Church, (see Illustration No. 3,) with mullions and cusped heads of 3 lights, like a window of the 15th or 16th century, but which is here set in the middle of the wall, and splayed alike through the wall on both sides in the same manner as the sound holes in the nave walls.

In conclusion, a few words as to the intention of the appliances. Vitruvius, Ode-le-Roy and the author of *l'Apocalypse de Méliton* have declared the purpose to be acoustic. Mons. Mandelgren expresses no opinion as to the Swedish example, yet it is conceivable that the five rows of jars in the vault of that little choir might have been intended to have the effect of checking the echo or reverberation of the chanting. The intention, whatever it was, ultimately was deemed superfluous when the vases were plastered out and lost to sight and sound. Mons. Didron had before him these particular instances and also that of the church of St. Blaise at Arles; he thought the appliances puerile for acoustic purposes, and was altogether sceptical as to their having any such purpose until he met with the declared purpose of Ode-le-Roy. The Abbé Cochet entirely believed the object of his examples to be acoustic, perhaps rather from the resemblance of his jars to French earthenware cornets or horns still in use for producing sound, as Mons. Didron shows, than from their disposition in the buildings; for in no case do his observations show acoustic arrangement. At the Swiss Nunnery described by Mr. Albert Way, at Fairwell, at Ashburton and Luppitt, and probably also at St. Blaise at Arles, there is a well-defined arrangement of jars in tiers in the walls, which, from the record of the Metz Chronicle, it is fair to deem, was designed for acoustic purposes. The Irish example gives a specimen of arrangement in the disposition of the jars, and of want of arrangement in their form, unless it is supposed that the variety of form was to produce a distinct tone from each, as Vitruvius would have had it. But Mr. Brash, who reports this instance, firmly believed in

the acoustic effect, and says that since the restoration of the chancel he has repeatedly tested them, and found that they make sounds, originating in the chancel, audible in an unusual degree in all other parts of the church. Nevertheless, I incline to say, with Mons. Didron, "Ce moyen d'acoustique me parait assez puéril,"* or, with the commentator on the chronicle of Metz, "Ecce risu digna." The five subterranean instances in England (one at Ipswich, three at Norwich, and one at Fountains Abbey) have all been styled "acoustic," and "doubtful," and "for warming." They undoubtedly form a class by themselves. The position of the jars beneath the floor militates altogether against the acoustic theory. Mr. F. G. Stephen (*The Builder*, 1864, p. 17) tried to connect Sir Thomas Browne, of Norwich, with the discovery at St. Peter-Mancroft. This once famous physician wrote a treatise on urn burial, in which an accidental remark shows that he was acquainted with the Vitruvian theory of acoustic vases; hence Mr. Stephens thought he might have contrived the arrangement under the chancel floor of that church for acoustic purposes; but, besides the extreme improbability of their being any acoustic contrivance in the arrangement, the age of the work suggests that it was made 100 years before Sir T. Browne was born (*The Builder*, 1864, p. 35, &c.). He published his work in 1658, or 203 years after the completion of the church, and was actually buried in the church in 1682. If the floors over the jars were the original, as Mr. Phipson seems to think, then, for heating purposes there should have been some marks of flaps or openings in the floor, whereby charcoal-dishes could have been handed in and removed. It may be thought that repeated repairs of the floor-boards may have obliterated traces of such fittings.

In the examples at St. Olave's, Chichester; Upton, Notts.; and Denford, Northamptonshire; at Newington and Sandwich in Kent, we return again to those having an elevated position. If acoustics had been considered, the means adopted seem altogether insignificant; whilst St. Olave's is so tiny a structure that one can hardly conceive an aid to sound being needed. It has been suggested that this instance might be connected with the keeping of relics. Some of these and of the previous instances suggest to me means for the suspension of hangings. In one or two of the instances the jars are probably ancient burial urns, accidentally discovered in or near their buildings by the mediæval builders, who, with a due sense of veneration for their original use, built them into their work in progress for preservation sake. In most cases the jars are simply domestic vessels. At Luppitt Church and at Leeds they were evidently expressly made for the purpose to which they have now been found applied, just as they were prepared for Ode-le-Roy at Metz. The instance, at Leeds Church, near Maidstone, it will have struck every one, has more indication of an acoustic purpose than any other. It certainly had the merit of being less obtrusive than the scheme carried-out by Ode-le-Roy. The age of the two projects is nearly the same, and, like the Metz instance, I suspect the Leeds trial had little success, and was soon covered-up and lost to sight as fully as it had been to sense.

Mr. E. P. LOFTUS BROCK, F.S.A.—Sir, this subject is one of great archæological interest, and perhaps it may be that some very practical result may follow this lecture and the discussion upon it. I think from the historical evidence, and the chronological order of date

* See Appendix B.

of these objects, going as we have heard from the lecturer over a great number of centuries, from the twelfth quite down to the period of the Reformation, that we may consider it a sort of tradition of the knowledge of the Vitruvian theory in classical times. I think we may certainly say that these articles of pottery, whether rightly or wrongly in their application, were intended for some acoustic purpose; but when I have said that, I certainly agree with the lecturer that the result must have been extremely dubious, and I would certainly not desire it to go forth from this Institute that we should be right in putting pots all over our churches or other buildings. I think that that would be a great mistake, although probably some practical arrangement of them may be found to do good in time to come. With respect to the articles themselves they are of very familiar types to archæologists, and may be readily recognized as the ordinary culinary implements or vessels of domestic use of the times, when they were used. They have not been made purposely. Certainly the pots at St. Peter-Mountergate, are ordinary fifteenth-century domestic articles, such as we find in almost every excavation of mediæval times. The handles prove that these are ordinary jugs of every-day use. The same remark applies to other examples on the Continent and elsewhere. The evidence thus points to the fact that they were articles of domestic use taken and applied for this especial purpose. It is a curious fact which we glean from the lecture as to the great number of these articles found in Norfolk and Suffolk. It seems as if some man had started the theory that earthenware vessels would improve the sound, and that may be the reason of their being used so much in the beginning of the fifteenth century. With respect to their use in the choirs of the churches, I should say it was the worst possible position in which they could be placed, because I think a musician would tell us that the notes would be prolonged by their resonance, and they would put the choir out of time instead of doing good. We may therefore look to the example at Leeds as being perhaps the best position of those named to us in which it could be placed, namely, in the nave. If one wanted to produce a long drawn-out sound—the sound like that of an æolian harp—we might probably come near it by the use of these pots in such a position. My memory serves me, since I have been listening to the lecture, to an instance of the cure of an echo, given in an early volume of *The Builder*, with regard to St. John's, Antigua. This was accomplished by lining the west end wall with boarding, kept away a few inches from the building, and in my own practice I have done a good deal towards stopping an echo by a similar arrangement. However, this plan, as we must see at a glance, would not be fit for all classes of buildings. We could not, for instance, in a church faced with stone or brick internally, have any such linings of wood in the end-wall. We could, however, use such pots as these. We all know by painful experience that the west wall of a church, or end-wall of any other large building, will throw back the sound. It may come about as a practical outcome of our meeting to night, to see whether or not in time to come it would not be possible to fill the west wall of the church with pots after this arrangement to help the resonance, when boarding cannot be used. If this should be the result I think our thanks are heartily due to Mr. Hills for bringing this subject before us, not only as one of curiosity, but also as a means of bringing about a real good.

THOMAS BLASHILL, *Fellow.*—It seems that although for many centuries a strong opinion has prevailed as to the utility of pots of this kind for some purpose or other, we are

not quite sure as to what the purpose might be; and we have no confidence in the success of the scheme for whatever purpose it was intended. I have paid some attention myself to it as opportunity offered. I remember seeing those pots in the wall of Denford Church, and I examined them as carefully as I could. They were some feet above the floor, and I had to climb up to them. My recollection of them is somewhat different from the shape as here shown, and I certainly came to the opinion that the bottom of the pots was towards the face of the wall, as in some of those instances mentioned by Mr. Hills. I thought there was some raggedness about the outer edges, which showed the end to be broken, and I put my hand through and fancied I felt the neck on the other side. If I had foreseen this Paper I would have spent more time and have carefully examined them. But, Sir, the reason why I venture to say a few words is that I happen to know that this fancy, if it be a fancy, did not by any means end at the time to which Mr. Hills has brought down his history. The idea that an object of some kind, of a hollow form, might be used in a building for increasing and improving sound has been carried-out at a much later date. One curious instance impressed itself very much on my mind. The objects used in the instance to which I refer were not pots, but the skulls of horses. Anyone who knows the anatomy of the horse knows that there are very large cavities in their skulls, in fact they are most remarkable and peculiar in that respect; and therefore if the skull of any animal be fit for such a purpose, that one would be selected. Thirty years ago I was present at a gathering in a large room in an old inn, called the Portway, about eight miles west of Hereford. Something brought the matter to the recollection of the landlord, and he stated that the floor of the room in which we were sitting was laid over a quantity of horses' skulls; he had been told indeed that two cart loads had been put there. I asked the reason, and he said, "to make the fiddle go better." It was a place where music and dancing sometimes went on. I was there two or three years ago, and they were altering the building. The place was surrounded by scaffolding, and on the top of every scaffold pole was a horse's skull. It was a nine-days' wonder, and the workmen had decorated the building with these strange objects. The way they were found was thus: Twenty-four of them were screwed through the eye holes to the under side of the floor boards in three rows. It was the ground floor, and nine of them were too much decayed to be examined. It would be necessary to test that room both with and without the skulls, and therefore I cannot say whether they made any difference. I remember also a paragraph in the papers about twelve or fifteen years since, where it was mentioned that in removing a floor, I think it was in Lancashire, the main beam was found to have been laid on horses' skulls, for what reason I cannot say, and I am afraid I cannot carry the argument further.

ARTHUR CATES, *Member of Council.*—I hope when this Paper is printed in the TRANSACTIONS Mr. Hills will add as an appendix the observations of Mr. Conyngham* with reference to the openings in the theatre at Saguntum, which may perhaps serve as a little comment on his own observations that vases were not found there. It is hardly likely the spoliators would have left the brazen vases there for us to find; but I think Mr. Conyngham went into some detail with regard to the application of the principles laid down by Vitruvius to these openings. Then there is another very curious instance which may serve to throw some light upon the advice of the Swedish architect that five rows of vases should be placed

* See Appendix A.

in the wall. In the complete editions of Terence there is generally printed, among other prefatory essays copied from early editions, an introductory essay by a commentator whose name and period are equally unknown. He there mentions the use of vases of brass for the purpose of increasing sound, and he says that "in certain temples of antiquity which have come down to our time there are at the foot of the vaults and also in the upper part rows of cavities in which brazen vessels were placed with the mouth turned outwards, which served to increase the distinctness and the melody of the voices of those who sang within the temple,"* which appears to be an almost exact description of the diagram which he exhibited of the Swedish church. There you have rows of openings or cavities at the base of the vault and rows at the summit of the vault. I think it would be quite desirable that that passage of the commentator of Terence should also be added to the Paper, and Mr. Hills will no doubt favour us with some further information, because we know the great advantage that is derived by the publication of the TRANSACTIONS at the close of the session, instead of being sent out in a crude state immediately after the reading of each Paper. In my opinion Mr. Hills's Paper may serve as the foundation for a very complete *corpus* of information on a subject of great interest, especially by the light of the interesting illustration which Mr. Blashill has given.

PROFESSOR KERR, *Fellow.*—It occurs to me to remark that the music of the ancients—a very simple affair—was composed on a different scale from ours, namely, the scale which is formed by the black notes of a pianoforte. It produced music of the minor key, and it occurs to me very probable that the bells—for they were obviously bells—which Vitruvius describes as having been placed in the ancient theatre, and which no doubt were introduced for the purpose of increasing the resonance, might be found to have more effect with that peculiar style of music. If so, then this pottery vase, if burnt hard, would have something of the same effect. It would have to be fixed loose, I should suppose; but it seems to me not at all an irrational idea to put such articles into churches where intoning, for instance—a species of music—was to be an important part of the service. While Mr. Hills was reading the Paper it seemed to me that he left the matter intentionally in a good deal of confusion; he seemed to be very sceptical indeed about the whole theory. But the discussion has put the case, I think, on different ground; and, as an outsider, I should say there is a scientific idea here which is worthy of investigation.†

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* Tale quiddam audio adhuc hodie exstare in quibusdam templis antiquis, quæ nunc quoque supersunt integra, apud nostræ tempestatis Græcos. In quorum fornice inferiore atque superiore varia sunt foramina hinc inde conspersa, ac sibi veluti ex diametro ab uno ad aliud latus correspondentia, in quibus vasa ænea impacta sunt, quorum os (quod Angustius est, quam ipse venter) tantum externis patet, non etiam prominet. In ea vasa, vox in templo canentium inclusa incredibilem efficit harmoniam, sonosque distinctissimos, et admodum gratos, atque auditu faciles. Sed in theatris vasa resupina suspendebantur. Tale quid autem Romæ factum fuisse suis temporibus negat Vitruvius, sed in Italiæ regionibus et in pluribus Græcorum civitatibus Unde Lucius Mummius diruto Corinthiorum Theatri ejus ænea vasa Romam deportavit. . . . Multi etiam Architecti, qui in oppidis non magnis Theatra construxerunt, propter æris inopiam, fictilibus doliis ita sonantibus electis, hac ratiocinatione compositis, usi sunt. . . . . Quapropter Plinius ait, in Theatris vocem optime cunere in doliis inanibus in ligneis autem Theatris (ait Vitruvius) quæ Romæ passim fiebant, non erat vasis æneis opus, quum tabulationes haberent complures, quas sonare necesse est.—*Publici Terentii Afri Comœdiæ* (Lemaire), Par. 1827, vol. I. p. lxxx. 1. *Ibid*, Lond. 1820, vol. I. p. lxxxiii. A. C.

† It ought to be borne in mind that the "applied science" of mediæval times was wholly empirical, so that allowance may be made to any required extent for mistakes whether of principle or of practice. R. K.

JOHN SLATER, B.A. (Lond.), *Fellow.*—While Mr. Hills was reading his Paper, it occurred to me that one of the vases shown is extraordinarily like some terra-cotta vases described by M. Victor Place in his splendid work on Explorations at Khorsabad. He there mentions that he found several such vases among the *débris* of the buildings which he examined, and, as far as I can remember, he says that these things had no bottoms, and were probably used as a sort of skylight in the flat roofs. That struck me as rather singular; and as Mr. Hills seemed uncertain whether any of the vases described by him were really intended to serve an acoustic purpose, it would be interesting to know whether any discovery of such terra-cotta vases in roofs or walls has been made in buildings of an earlier date than any he has mentioned, as this might throw some light on this curious and interesting subject. It is to gain some information on this point that I have made these few remarks.

THE CHAIRMAN.—Mr. Slater is correct in saying that Victor Place, who describes a number of earthen tubes as having been found at Khorsabad, believes that those were inserted for the purpose of giving light. It is not uncommon in the East to have domes lighted by perforated openings, which give a beautiful, subdued light. I had an opportunity a short time ago, at the theatre at Argos (where there were no remains of pots) of trying how the voice would sound in a Greek theatre. I was there with two first-rate archæologists, a clergyman and some others; and we asked the clergyman to stand down on the site of the stage. We were up on the steps at about three-quarters of the height. The theatre, when perfect, was nearly 500 feet diameter, and the orchestra part, in which the chorus used to perform, was 200 feet diameter. To give you an idea of the size of it, and the difficulty of speaking, I may say that orchestra would have held the whole of Covent Garden Theatre, its boxes, corridors and walls, and left a very good space besides. There was a brisk wind blowing right across. The clergyman spoke in about the same tone of voice as he would use in a large church, and we heard distinctly. There were some things in favour of his speaking and some against. For instance, in his favour, we were all attentively listening, and there was none of the buzzing which a large number of spectators might have created. On the other hand, he was quite on the floor, not raised as he would be ordinarily on the stage. He had, again, no back wall which would throw his voice forward, nor had he the *velaria,* nor the side curtains or walls, which would have kept out the wind and aided his voice. It was a perfectly successful experiment of speaking in the open air. With regard to Fountains Abbey, I only speak from memory; but when the Abbey was cleared, the late Earl de Grey sent a number of reports, stating how the work proceeded, and among them was a very careful account of the pots there. The subject divides itself into several heads: as to their use, first, in vaults; secondly, in walls; and thirdly, a totally distinct class, like those in Fountains Abbey and Norfolk, which are entirely underneath the floor. It is a vast pity that those pots were not left in Leeds Church. We might then have had the opportunity of trying if they added to the resonance or the acoustic properties of the building.

GORDON M. HILLS, *Associate.*—Allow me to thank you for the kind way in which my endeavours have been received. Mr. Cates has placed before us valuable remarks deserving to be fully and distinctly recorded. The reference to the annotator on Terence which he has produced forms to my mind a very valuable adjunct indeed to our subject. It cannot be doubted that the Vitruvian arrangement may—I might almost say must—have produced a sounding and resonant effect. As Professor Kerr says, the brazen *echeia* were, in fact, bells,

and, as I understand Vitruvius, they were placed with the mouth of the bell downwards, supported in front by a small block, or, as it is translated, " wedge," six inches in height. At the back part the lip of the bell would seem to have rested on solid work; under the bell was a hollow space two feet long in front, extending therefore beyond the width of the bell. Vitruvius expressly tells us that the operation of the contrivance was that of a sound striking against the outward surface of the vase. I am very far from saying that earthenware pots would have the same effect upon the resonance. Vitruvius tells us that they did, and that they were successfully introduced in some of the smaller theatres; I presume they were introduced in the same manner, and may have been made, as Professor Kerr has suggested of hardened and refined pottery. We all of us know that glass is extremely resonant, and if it had been thought to put glass vases I can imagine some ground for the belief that the effect was considerable. I am not willing to say that such a complete arrangement as Ode-le-Roy put up, or as we have it at Leeds Church, would not have had some effect. Sounds and their effects on the vibrations of air are extremely subtle—in fact, we know little about them. Although a great deal has been done in the way of measuring vibrations and studying the nature of them of late years, one may almost say that whatever little you do would have some effect. We know the great difference in the effect of the voice between an empty room and a full one, and we know, therefore, that the entry of every individual into that room must make some difference in the vibrations of sound and the transmission of it. It interrupts certain rays of the voice, and the addition of a single individual makes a difference, though we cannot appreciate it; but, after all, I come to this that the mediæval examples seem to have been done and executed in the belief that they would produce sound, and in each case as far as we know or can infer they failed. Of course there is the account given by the author of *L'Apocalypse de Méliton*, who positively states that six men made as much noise with the aid of the vases as forty would have done in another place. Nevertheless, the use of them having died out it is pretty clear that the belief in their use had died out too. In the case of the Church of the Célestins, at Metz, we see that the failure of the contrivance was acknowledged in the course of a few years, whilst the use of the contrivance and belief in its effect continued in other places for more than two centuries later. I believe Mr. Blashill is mistaken with reference to the Denford example, when he thinks the bottom of the vase was turned to the inside of the church, though it makes little difference if the bottom was broken away, as he represents, so as to give a mouth to the vase at the bottom; and the description was given with good detail at the time of the discovery, in *The Builder*, by Messrs. Wadmore and Baker, the architects who made the discovery. They expressly state that the mouth is the exposed part, and give measurements and forms of the vases, in a manner which shows they were not likely to have mistaken the position of the jars. As to the point raised by another gentleman, that the vases possibly acted merely in the way of tubes, the only instances of a perforated bottom are those at Leeds, where the whole of the jars are perforated. I have doubted whether those jars could have been made for the purpose for which they were used there, nor have I met with any one who could suggest for what purpose they had been made with these perforated bottoms; but the perforation was perfectly abolished when placed as they were, because they were built in the wall with 14 to 18 inches of solid work behind the perforation, and in every case the mortar had filled the perforation; the perforation,

therefore, had nothing to do with the purpose of producing or regulating sound. The instances related where open tubes were found in vaulted roofs I take to be purely constructive: the effect intended being sometimes merely to avoid weight in construction, and at other times the admission of light, as the Chairman said. For the latter purpose the idea is not limited only to vaults. At Constantinople and elsewhere in the east, where a powerful glare of light has to be subdued, the windows are filled by thick slabs of stone, perforated with cylindrical holes 4 to 6 inches diameter. I myself used this plan with very good effect in building the Church of the Holy Trinity at Sliema, in Malta, in the windows exposed to the glare of the south sun. I may say that this method allowed of the introduction of stained glass in all the openings. During this evening's discussion one of our members has called my attention to the two ideas created in the minds of those present as to the effect of the contrivances under consideration. The minds of some have dwelt on the contrivances as intended to produce resonance, whilst the opposite idea, that in effect they would counteract and baffle resonance or reverberation, has found considerable expression. To me it seems that, if any effect were gained under this first or Vitruvian idea, it would be decidedly objectionable for acoustic reasons; the effect would be the scurring of notes, one sound running into another. As to the second idea, there is no evidence that the authors of the contrivances ever entertained it; the evidence is that they aimed at resonance. Believing, as I have already said, that for any purpose of affecting the sound the contrivances are puerile, I am led to express the hope that we may not find any of our churches disfigured by a modern return to them. The examples in Chaldæa will be found by those who may see the Paper in print, or the original notices of them in *The Builder*, to be distinctly constructive. I have purposely avoided this hollow pottery used for constructive purposes, and have intended to restrict my subject to the cases where the purpose related to sound.

APPENDICES TO MR. GORDON M. HILLS'S PAPER.

A.

VITRUVIUS. Lib. I, cap. I. (Schneider's edition).—*Quod sit architectura, &c.*

"Item in theatris vasa æerea quæ Græci ἠχεῖα vocant in cellis sub gradibus collocantur, et mathematica ratione sonituam discrimina ad symphonias musicas sive concentus componuntur divisa circinatione in diatessaron et diapente et diapason; uti vox scenici sonitus conveniens in dispositionibus, tactu cum offenderit, aucta cum incremento, clarior et suavior ad spectatorum perveniat aures."

GWILT'S TRANSLATION.

"So the vessels called ἠχεῖα by the Greeks, which are placed in certain recesses under the seats of theatres, are fixed and arranged with a due regard to the laws of harmony and physics, their tones being fourths, fifths, and octaves; so that when the voice of the actor is in unison with the pitch of these instruments, its power is increased and mellowed by impinging thereon."

VITRUVIUS. Lib. V, cap. V. (Schneider's edition).—*De Theatri Vasis.*

"Ita ex his indagationibus mathematicis rationibus fiant vasa æerea pro ratione magnitudinis theatri; eaque ita fabricentur, ut, cum tanguntur, sonitum facere possint inter se diatessaron, diapente, et ex ordine ad disdiapason. Postea inter sedes theatri constitutis cellis ratione musica ibi collocentur ita, uti nullum parietem tangant, circaque habeant locum vacuum et a summo capite spatium; ponanturque inversa (1),* et habeant in parte quæ spectat ad scenam suppositos cuneos ne minus altos semipede; contraque eas cellas relinquantur aperturæ inferiorum graduum cubilibus longæ pedes duos altæ semipedem. Designationes autem earum quibus in locis constituantur sic explicentur. Si non erit ampla magnitudine theatrum, media altitudinis transversa regio designetur, et in ea tredecim cellæ duodecim æqualibus intervallis distantes confornicentur, uti ea echea (2), quæ supra scripta sunt, ad neten hyperbolæon sonantia in cellis, quæ sunt in cornibus extremis, utraque parte prima collocentur; secunda ab extremis diatessaron ad neten diezeugmenon; tertia diatessaron ad neten parameson; quarta [*diapente*] ad neten synemmenon (3); quinta diatessaron ad mesen; sexta diatessaron ad hypaten meson; in medio unum diatessaron ad hypaten hypaton. Ita hac ratiocinatione vox ab scena uti ab centro profusa, se circumagens tactuque feriens singulorum vasorum cava (4), excitaverit aucta claritate ex concentu convenientem sibi consonantiam. Sin autem amplior erit magnitudo theatri, tunc altitudo dividatur in partes quatuor; uti tres efficiantur regiones cellarum transversæ designatæ, una harmoniæ, altera chromatos, tertia diatoni: et ab imo quæ erit prima, ea ex harmonia collocetur ita, uti in minore theatro supra scriptum est. In mediana autem parte prima in extremis cornibus ad chromaticen hyperbolæon habentia sonitum ponantur; in secundis ab his diatessaron ad chromaticen diezeugmenon; in tertiis diapente ad chromaticen synemmenon; in quartis diatessaron ad chromaticen meson; quintis diatessaron ad chromaticen hypaton; sextis ad paramesen, quod et ad chromaticen hyperbolæon diapente, et ad chromaticen meson diatessaron habent consonantiæ communitatem. In medio nihil est collocandum ideo, quod sonituum nulla alia qualitas in chromatico genere symphoniæ consonantiam potest habere. In summa vero divisione (5) et regione cellarum, in cornibus primis ad diatonon hyperbolæon fabricata vasa sonitu ponantur; in secundis diatessaron ad diatonon diezeugmenon; tertiis diatessaron ad diatonon synemmenon; quartis diatessaron ad diatonon meson; quintis diatessaron ad diatonon hypaton; sextis diatessaron ad proslambanomenon diapason, et ad diatonon hypaton diapente habet symphoniarum communitates. Hæc autem si quis voluerit ad perfectum facile perducere, animadvertat in extremo libro diagramma musica ratione designatum, quod Aristoxenus magno vigore et industria generatim divisis modulationibus constitutum reliquit: de quo si quis ratiocinationibus his attenderit, et ad naturam vocis et ad audientium delectationes facilius valuerit theatrorum efficere perfectiones. Dicet aliquis forte, multa theatra Romæ quotannis facta esse, neque ullam rationem harum rerum in his fuisse. Sed erravit in eo, quod omnia publica lignea theatra tabulationes habent complures, quas necesse est sonare. Hoc vero licet animadvertere etiam a citharœdis, qui superiore tono cum volunt canere, advertunt se ad scenæ valvas, et ita recipiunt ab earum auxilio consonantiam vocis. Cum autem ex solidis rebus theatra constituuntur, id est ex structura cæmentorum, lapide, marmore, quæ sonare non possunt, tunc ex his hac ratione sunt explicanda. Sin autem quæritur, in quo theatro ea sint facta, Romæ non possum ostendere; sed in Italiæ regionibus et in pluribus Græcorum civitatibus: etiamque auctorem habemus L. Mummium, qui diruto theatro Corinthiorum ejus æenea Romam deportavit, et de manubiis ad ædem Lunæ dedicavit. Multi autem solertes architecti, qui in oppidis non magnis theatra constituerunt, propter inopiam fictilibus doliis ita sonantibus electis, hac ratiocinatione compositis perfecerunt utilissimos effectus."

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* The figures refer to the notes made by M. Maufras (see next page).

GWILT'S TRANSLATION.

"On the foregoing principles the brazen vases are to be made with mathematical proportions, depending on the size of the theatre. They are formed so as, when struck, to have sounds, whose intervals are a fourth, fifth, and so on consecutively to a fifteenth. Then, between the seats of the theatre, cavities having been prepared, they are disposed therein in musical order, but so as not to touch the wall in any part, but to have a clear space round them and over their top: they are fixed in an inverted position (1), and on the side towards the scene are supported by wedges not less than half a foot high; and openings are left towards the cavities on the lower beds of the steps, each two feet long, and a half a foot wide. The following is the rule for determining the situations of these vases. If the theatre be of moderate size, they must be ranged round at half its height. Thirteen cavities are prepared at twelve equal distances from each other, so that those tones (2) above-named, producing netè hyperbolæôn, are to be placed in the cavities at the extreme ends; second, from the ends, the vessels are to be of the pitch of netè diezeugmenôn, bearing an interval of one fourth from the last mentioned. The third netè paramesôn, an interval of another fourth. The fourth, netè synemmenôn, another fourth (3). The fifth, mesè, a fourth. The sixth, hypatè mesôn, a fourth: in the centre of the range, hypatè hypatôn, a fourth. By the adoption of this plan, the voice which issues from the scene, expanding as from a centre, and striking against the cavity of each vase (4), will sound with increased clearness and harmony, from its unison with one or other of them. If, however, the theatre be on a larger scale the height is to be divided into four parts, so that three ranges of cavities may be provided, one for harmonic, the second for chromatic, and the third for diatonic vases. That nearest the bottom is for the harmonic genus, as above described, for a lesser theatre. In the middle range on the extremities, vases producing the chromatic hyperbolæon are placed: in the second cavities the chromatic diezeugmenon, a fourth from the last: in the third, at another interval of a fourth, the chromatic synèmmenon: in the fourth, the chromatic meson, another fourth: in the fifth, the chromatic hypaton, another fourth: in the sixth, the paramesè, which is a fifth to the chromatic hyperbolæon, and a fourth to the chromatic meson. In the centre none are to be placed, because no other sound in the chromatic genus can be in consonance therewith. In the upper division (5) and range of the cavities the vases on the extremities are constructed to produce the tones of the diatonic hyperbolæon: in the next cavities, those of the diatonic diezeugmenon, a fourth: in the third, of the diatonic synèmmenon, a fourth: in the fourth, of the diatonic meson, a fourth: in the fifth, of the diatonic hypaton, a fourth: in the sixth, proslambanomenos, a fourth: in the centre, mesè, between which and proslambanomenos is an octave, and a fifth between it and the diatonic hypaton. He who is desirous of more fully understanding these matters must refer to the musical diagram at the end of the book, which is that left to us by Aristoxenes, who with much intelligence and labour formed a general scale of the tones. Hence, he who carefully attends to these rules, to the nature of the voice, and to the taste of the audience, will easily learn the method of designing theatres with the greatest perfection. Some one may perchance urge, that many theatres are yearly built in Rome, without any regard to these matters. But let him not be herein mistaken, inasmuch as all public theatres, which are constructed of wood, have many floors, which are necessarily conductors of sound. This circumstance may be illustrated, by consideration of the practice of those that sing to the harp, who, when they wish to produce a loud effect, turn themselves to the doors of the scene, by the aid of which their voice is thrown out. But when theatres are constructed of solid materials, that is of rubble, squared stones or marble, which are not conductors of sound, it is necessary to build them according to the rules in question. If it be asked what theatre in Rome can be referred to as an example of their utility, we cannot produce one, but such may be seen in some of the provinces of Italy, and many in the Grecian States. We moreover know that L. Mummius, on the destruction of the theatre at Corinth, brought to Rome some of its brazen vases, and dedicated them as spoils at the temple of Luna. Many clever architects who have built theatres in small cities, from the want of other, have made use of earthen vessels, yielding the proper tones, and have introduced them with considerable advantage."

The following translation of Notes by M. Ch.-L. Maufras (see *L'Architecture de Vitruve traduction nouvelle par M. Ch.-L. Maufras, membre de la Société des Antiquaires de Normandie, &c., Paris*, 1847, *8vo.*), referring to passages in the foregoing extract from the Fifth Chapter of the Fifth Book of Vitruvius, will assist inquiry into the question of these brazen vases:—

"1.—*Ponanturque inversa.* This expression *inversa* ought not to be taken literally. The diagram (see Illustration No. 5) represents one of these vases, with its opening *a o e* turned towards the stage at such an

inclination that if you imagine a line drawn from the centre of the vase *d* to the middle, *o*, of its opening, such line would come to the middle of the stage. In large theatres the inclination of the vases should be greater or smaller according to whether they are placed in niches at the top, or in the middle, or at the bottom of the building. These vases rest on props *c n* placed under the part nearest to the stage. Now these props should not be less than half a foot in height, according to Vitruvius, who doubtless did not mean to refer to the other prop *r*, the height of which should vary according to the plane on which the vases stood under the steps.

"2.—*Uti ea echea.* Whenever the Greeks built substantial and large theatres they perceived that the voices of their actors could not reach to the ends of the building, and they determined to supply some means by which increased force and clearness would be gained. With this end they conceived the idea of placing, in niches formed under the steps of the theatre, vases of brass, possessing all the tones of the human voice, and even the whole range of sounds of their instruments, in order that all sounds issuing from the stage might strike some one of these vases, according to the relation between them, and gain by their consonance a much greater distinctness of sound.

"Pompey was the first who built, at Rome, a magnificent theatre of stone and marble, in imitation of the one at Mitylene, whence he obtained the plan. We see in this chapter that this was the only one existing in the time of Vitruvius. Marcellus constructed another in the ninth region of Rome, and Augustus opened it.

"Theatres built of stone soon multiplied; four could be counted in the camp of Flaminius alone. Trajan erected one of the most beautiful of them, which Hadrian afterwards destroyed. These stone theatres were not so favourable to the voice as those of wood, which, being boarded all over, formed a sort of immense case, which produced on a large scale the same effect as that of the hollow body of a violin. To obviate this difficulty they had recourse to the ingenious plan of the Greeks, all the details of which are found here.

"Vitruvius tells us nothing of the shape of these vases, but, as he adds that they were reversed and held up, on the side of the stage, by props half a foot in height, it is very probable that they were nearly of the shape of a bell, or of a bell of a clock, as being most suitable to the reverberation of sounds. The sole object of these vases was to increase the sound of the voice, by making it re-echo, unless there was an idea of striking them with hammers, as Cesariano and Père Kirker have thought.

"At the beginning of some editions of the comedies of Terence there is to be found a short treatise in which the commentator, whose name is unknown, speaks of vases of brass, concerning which there was some difference of opinion. He assigns to them the same use as Vitruvius, and he then adds: 'I hear that there exists to this day something very like them, in some ancient temples, which have been preserved in their integrity down to our time. At the lower and upper parts of the roof are to be seen holes distributed on both sides, and corresponding diametrically with each other. In these holes are set vases of brass, the opening of which is smaller than the body, and is turned outwards, without projecting. The voices of those who sing in the temple, reverberating in these vases, grow more distinct and harmonious.' There is nothing in these words which is not quite in accordance with facts.

"3.—*Quarta diatessaron ad neten synemmenon.* The vases which give the shrillest sounds were placed towards the ends of the theatre, and those which give the lowest sounds were set in the middle. It is in the middle that the reverberation of the voice is most clearly felt, because there the sounds collect together. It is also proper to give this place of advantage to the vases which repeat deep tones, the range of which does not reach as far as that of the shrill sounds.

"Père Kirker and Perrault, following Meibomius, substitute the word *diapente* for *diatessaron*, and interpret the author's words to mean that the nete-synemmenon was in harmony with the fifth with the nete-hyperbolæon. They all three pretend that the same error still creeps twice into cases absolutely like, where Vitruvius speaks of rows of vases intended for chromatic and diatonic sounds that are placed in large theatres, and wish that they were corrected in the same way. Now, says de Bioul, this very expression, constantly repeated under the same circumstances, should have persuaded them to the contrary. It is not that they were wrong in saying that the nete-synemmenon with the fifth with the nete-hyperbolæon; but the author intended to say something else, as we shall now see.

"Let us consider the five tetrachords, which the ancients used, as divided into two parts: the one contained the three first, that is to say, hypaton, meson, and synemmenon; the other the two last, that is to say, diezeugmenon and hyperbolæon. Then the author names first the three sounds of nete-hyperbolæon, nete-diezeugmenon and paramese, while adding that they agree with each other to the fourth, as they make it in effect. Afterwards he names the sounds of the two following tetrachords, as detached, as not having any relation with those of which he has just spoken, so although, when he says that nete-synemmenon agrees to

the fourth, he does not mean that it is with the sounds of which he has already spoken, but with that which he is going to name next, that is to say, with mese, which agrees also to the fourth with hypate. The author was then right in saying : *diatessaron ad neten synemmenon.*

"This is how the tones of the harmonic kind were distributed in the small theatres, which had only a single row of vases.

1.	2.	3.	4.	5.	6.		6.	5.	4.	3.	2.	1.
Nete-hyperbolæon.	Nete-diezeugmenon.	Paramese.	Nete-synemmenon.	Mese.	Hypate-meson.	Hypate-hypaton.	Hypate-meson.	Mese.	Nete-synemmenon.	Paramese.	Nete-diezeugmenon.	Nete-hyperbolæon.

"4.—*Tactuque feriens singulorum vasorum cava.* In large theatres three rows of vases are placed for the three rows. Those in the lowest row, intended to render the sounds of the harmonic kind, were distributed in the same manner as we have seen they were in the small theatres ; those in the middle row were for the sounds of the chromatic kind, and those in the highest row for the sounds of the diatonic kind.

"Vitruvius, speaking of the vases which compose the second row, neglects to give the sounds which they ought to render ; he contents himself with naming the tetrachords on which they bordered. It is easy, however, to distinguish also the sounds, because he specifies some of them, and the others can be found by intervals of a fourth, a fifth, and an eighth, of which he expresses the distance from those which are specified. For example, he says that the vase of the sixth niche of that row sounded paramese, and that it was adjusted with that which gave hyperbolæon in the first, and to the fourth with meson; now the fifth of paramese in hyperbolæon is trite, and its fourth in meson is lichanos. After that, since all other sounds agreed with each other, to the fourth, it is easy to find them all by means of the table. The first vases ought then to sound trite-hyperbolæon, which is the fifth of paramese ; the second vases, trite-diezeugmenon ; they formed between them a harmony of a fourth ; the third sounded paranete-synemmenon ; the fourth, lichanos-meson ; the fifth, lichanos-hypaton : these three last agreed to the fourth with each other and with lichanos-meson, which is the fourth of paramese fixed by the author.

"Perrault, Kirker and Meibomius still read *diapente*, where the author writes *diatessaron ad chromaticen diezeugmenon ;* their scale also differs from that which follows.

"Order of the vases of the second row for the chromatic kind :—

1.	2.	3.	4.	5.	6.	6.	5.	4.	3.	2.	1.
Trite-hyperbolæon.	Trite-diezeugmenon.	Paranete-synemmenon.	Lichanos-meson.	Lichanos-hypaton.	Paramese.	Paramese.	Lichanos-hypaton.	Lichanos-meson.	Paranete-synemmenon.	Trite-diezeugmenon.	Trite-hyperbolæon.

"5.—*In summa vero divisione.* In speaking of the sounds of the diatonic kind, employed for the third row of vases, the author limits himself again to naming the tetrachords ; but as he assigns to the sixth niche, proslambanomenos, and to that of the middle, mese, which makes the octave of proslambanomenos, and the fifth with one of the chords of tetrachord hypaton, it may be easily understood that this one cannot be other than lichanos-hypaton, which forms a harmony of the fifth with mese.

"Then, since all the other sounds should harmonize to the fourth with some of those, it can easily be demonstrated, with the assistance of the table, that these other sounds should be those of paranete-hyperbolæon, and of paranete-diezeugmenon, which agree with each other to the fourth, and with mese, which is specified ; then those of paranete-synemmenon, of lichanos-meson, and of lichanos-hypaton, which agree with each other, also to the fourth, and with lichanos, of which the author himself fixes the tone, calling it the fifth of mese.

"We have seen the order of the rows which contain the sounds of the harmonic and chromatic kinds; here is that of the diatonic kind :—

1.	2.	3.	4.	5.	6.		6.	5.	4.	3.	2.	1.
Paranete-hypaton.	Paranete-diezeugmenon.	Paranete-synemmenon.	Lichanos-meson.	Lichanos-hypaton.	Proslambanomenos.	Mese.	Proslambanomenos.	Lichanos-hypaton.	Lichanos-meson.	Paranete-synemmenon.	Paranete-diezeugmenon.	Paranete-hypaton.

An extract (translated) from Patte's *Essai sur l'Architecture Théatrale* (p. 51), published in Paris in 1782, is as follows :—

"The Greeks conceived the idea of distributing small cells from point to point, in the middle of the rows of seats, in each of which they would place a resounding vessel or brass vase, in shape not unlike a bell. These vases were isolated and supported in an inclined position by an iron prop in the middle of the cells. They were proportioned according to certain methods of music in such a way as to sound when struck, either to a third, or to a fourth, or to a fifth from each other, and to produce all the chords up to the double octave. The cells were at most two feet square, with an opening made in each between the steps, and turned towards the stage, by which the tones of the voice penetrated within these hollows, whence they were thrown back with force by the resonance of the brass vases. . . . .

"It is possible that there was a kind of sympathy between these reverberations not unlike that which may be noticed between two strings of different lutes, which are near one another in the same room, and in unison; it is known that one cannot be touched without the other giving back a sound. May we not derive some explanation of the effects arising from these brass vessels by what sometimes occurs in a coppersmith's shop, or in some other place where there are many hollow vases? However little attention be given to it, it is seen that, in speaking in a certain tone of voice, some piece is heard to resound, which is found to be beyond doubt in unison with the tone in question, while the others remain silent, and that, if the tone of the voice be changed, it is another piece that answers back. It was probably the working of all these reverberations that the ancients had studied, which formed the basis of those artificial aids, of which they made use to alike strengthen and concentrate the actors' voices in their theatres.

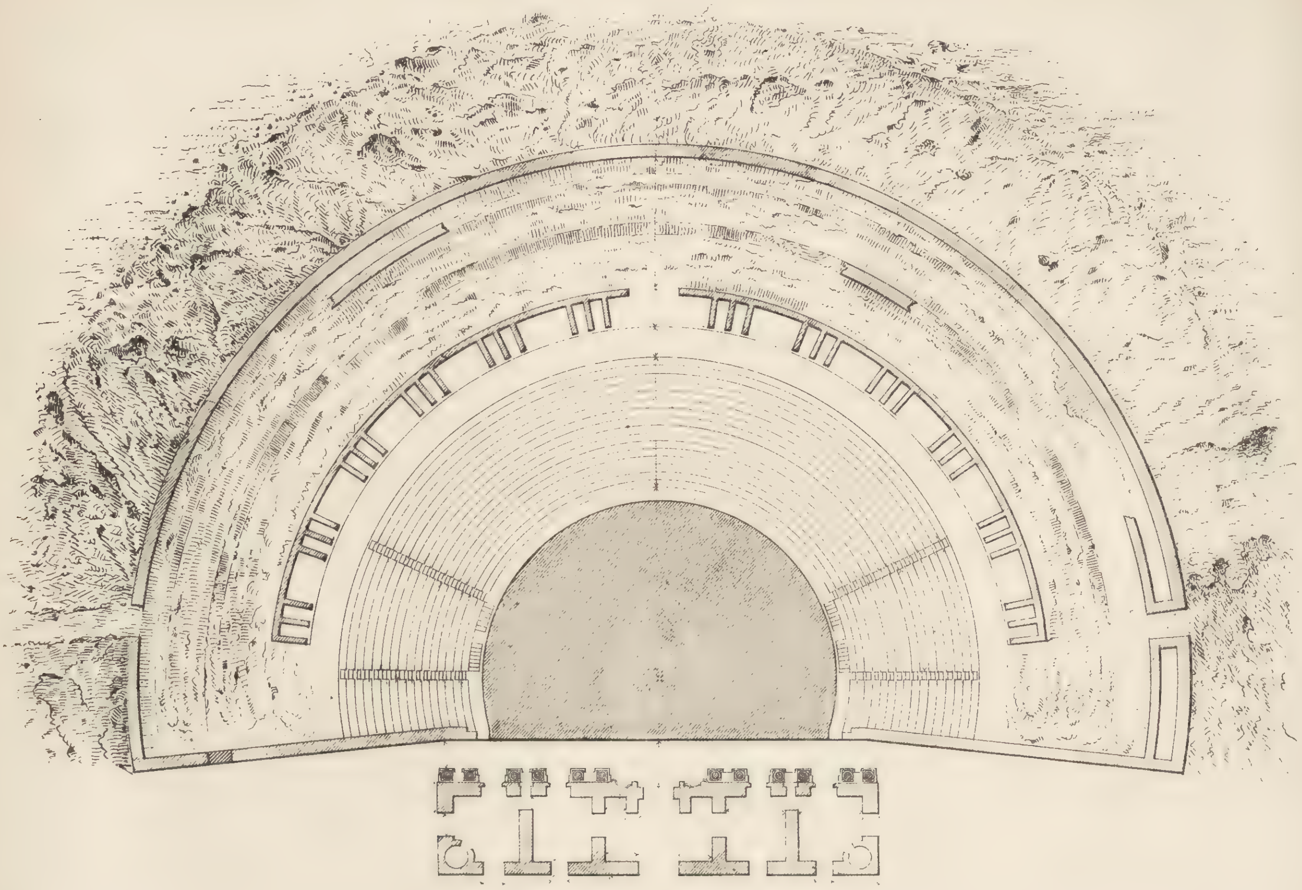
"Whatever there may be in these conjectures there appears to have been considerable art displayed in proportioning these brass vessels, and in distributing them round the circumference of the seats; for Pliny says that in his time they produced a baneful effect. We do not know enough of the music of the Ancients to appreciate to what degree this artificial means would augment the force of sound; but it was assuredly necessary for them to adopt some effective means of assisting the actors in making themselves heard in places so vast as their theatres, unprovided with a solid roof, where the audience were sometimes nearly 120 feet distant from the stage, and where there reigned, in spite of the attendant police, a sort of buzzing noise, always inevitable in a large gathering of people, full of men oftentimes who did not care to hear what was going on. The extreme passion that we know they had for scenic performances should lead us to conclude, besides, that they derived pleasure from them; now this pleasure only coming to them, in great measure, by means of their ears, is it probable that they would have had so much liking for it if they had not heard properly the pieces that were represented?

"The Greeks and the Romans used equally, as is said, to derive great advantage from the actors' masks, to add force to their voices; for they always played in masks, which, differing from ours that only cover the face, enveloped the entire head, and also exhibited the mouths excessively wide and large: this kind of mask has given rise to the conjecture, with much appearance of truth, that they had concealed there some kind of horn which contributed to increase the force of the voice. We read in the 51st Epistle of Cassiodorus, that the actors' voices were so strengthened by *concavités* that it was difficult to believe they could issue from the chest of a man; now these *concavités* could only be the brass vases and the horns of the masks.

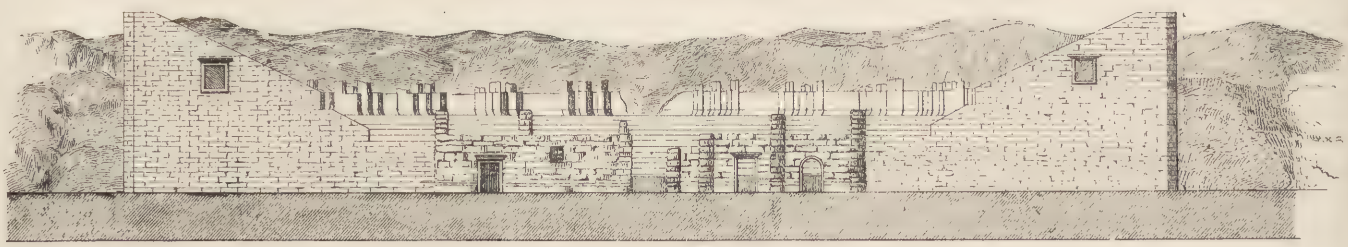
"Whatever opinion, moreover, we hold about these artificial aids with which the Ancients succeeded in increasing the volume of the voice in their theatres, everything, nevertheless, leads to the belief that their immense size, without any solid roof, must have been prejudicial to sound: they contained too many people

TRANSACTIONS OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS, 1881-82.

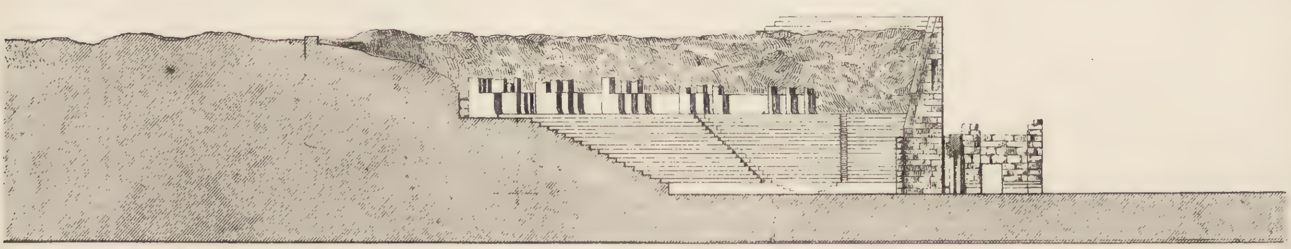
APPENDIX (A) TO MR GORDON M. HILLS'S PAPER, (No 4)



Plan



Elevation



Section

SCALE OF 100 50 0 50 100 METRES

Remains of the Theatre at Aizani.

(from Engravings in Texier's "Description de l'Asie Mineur.")

C. F. Kell, Lith. Castle St. Holborn, London. E. C.

for each one to be able with comfort to enjoy the spectacle; they could not see properly objects on the stage from the higher rows of seats, more especially on account of the kind of obscurity produced by the sail cloths which protected them; in short, the brass vases distributed artistically were successful in strengthening the sound of the voice, giving it more body, increasing its compass, and fixing its reverberations in the midst of the audience, but were they equally successful in producing distinctness of articulation? Would they not bring about some echo or redundance capable of smothering it, or of causing some detriment to it? This, as we think, is a matter we may venture to doubt."

Professor Donaldson, at page 39 of the *Antiquities of Athens, &c., Stuart and Revett, Supp. Lond.* 1830, *fol.*, has the following reference:—

"Ere we quit the Κοῖλον, we must not omit noticing the ἠχεῖα, or modulating vases, mentioned by Vitruvius; for although it is a subject, at this time, difficult of just appreciation, yet as they occupy so important a portion of the Treatise of our classic author, to pass them by altogether might appear an unpardonable inadvertency. It is now generally admitted that the communication of sound is produced by the reverberation of the air; for the sound of the voice issuing from the mouth as a centre, vibrates through the air in circles, infinite as those produced on the surface of water by the fall of a stone, and like them, the more remote they become, the more feeble their centrifugal power, and the less effective their impression on the air, till lost in the distance. But, whereas on the water the circles are merely superficial, the vibration in the air expands in all directions, proceeding however to a greater extent upwards and in front than it does laterally or behind the speaker. By the properties of acoustics, if two instruments in perfect harmony be placed within the sphere of each other's power, and the chord of one be struck, the chord of the other will vibrate the note to a sensible degree. This vibration of the second instrument will, of course, extend the sound of the first to a greater distance. Acting upon this principle, which particularly suited the recitative in which the epic and dramatic compositions were delivered, the Ancients had echea of earth and metal modulated to the intervals of the different notes of the voice, placed in small cells under the seats in one, two, or three rows, according to the extent of the theatre. Hence it resulted that the voice, parting from the scene as the centre, expanded itself all round, and striking the cavity of those vases, produced a clear and more distinct sound by means of the consonance of these different modulated tones, and extended the powers of the speaker to the utmost limits of the koilon. The vases were in the shape of a bell, placed in an inverted position, the side towards the audience resting on a pedestal not less than half a foot high, in all other respects quite free from contact: and in order to allow the vibration of the sound, a small aperture was left in the front of the seat, about two feet long and half a foot high. . . . .

"At Nicopolis are the ruins of two Roman theatres, both of which are in a very fair state of preservation, as far as regards the walls, but the marble decorations are utterly removed. In the larger, the podium of the centre præcinctio has eight niches, apparently adapted for the reception of vases, and there are also three wells sunk in the body of the cavea, made probably for the advantage of the sound, on the principle of Aristotle, noticed by Alberti, lib. viii, cap. vii. The scene has the hemicycle in the centre, and the three doors, and was about 110 feet wide."

Irby and Mangles, at page 301 of their *Travels in Egypt and Nubia, Syria and Asia Minor*, 1823, have the following reference:—

"Bysan, the Bethsan of Scripture, afterwards called Scythopolis . . . . the principal object is the theatre . . . . . it has this singularity above all other theatres that we have ever seen, viz., that those oval recesses half-way up the theatre, mentioned by Vitruvius as being constructed to contain the brass sounding tubes are found here . . . . . . We were quite at a loss what use to apply these very curious cells to; there are seven of them."

Mazois, in *Les Ruines de Pompéi* (Vol. IV. p. 71, footnote), *Paris*, 1838, *fol.* has the following reference:—

"On assure que M. Bankes a trouvé, dans le théâtre de Scythopolis, en Syrie, des chambres qui ne peuvent avoir servi qu'à placer ces vases à échos dont on n'avait trouvé aucun exemple jusqu'ici, et que l'on soupçonnait n'être qu'un raffinement imaginé par Vitruve. M. Ambroise Firmin Didot nous apprend, dans l'intéressant ouvrage qu'il a publié sous le titre de *Notes d'un voyage fait au Levant en* 1816 *et* 1817, qu'un usage semblable s'est conservé, sans doute par tradition, dans la ville de Cydonie, en Asie Mineure, où il séjourna longtemps dans le célèbre gymnase, qui fut détruit peu de temps après ainsi que la ville, lors de l'insurrection Grecque."

Texier, in his *Description de l'Asie Mineure* (Vol. I. page 113) *Paris*, 1839, *fol.*, describes the ruins of the theatre at Aizani (see Illustration No. 4):—

"La salle ou *cavea* du théâtre d'Aizani est assez bien conservée dans sa partie inférieure. Il y a seize rangs de gradins tous de marbre dans la première précinction, mais tout ce qui appartient à la précinction supérieure est complètement detruit. Le mur de soutènement (diazoma) de la seconde précinction, quoique en partie détruit, conserve une disposition que je n'ai pas remarquée dans d'autres théâtres: ce sont des niches ou cellules accouplées deux à deux, et dont les parois sont faites d'une seule pièce de marbre blanc. On ne voit point quelle pouvait être l'utilité de ces loges, si ce n'est d'avoir recelé un système de corps sonores ayant la forme de vases, que l'on plaçait dans la précinction. . . . Le plan du théâtre d'Aizani est d'autant plus d'accord avec les dispositions indiquées par Vitruve, que, selon la règle qu'il établit, ces groupes de cellules sont au nombre de douze, et placés, comme il l'entend, au milieu de la hauteur du théâtre. J'avoue que je n'ai jamais rencontré une disposition semblable dans les autres théâtres, quelque bien conservés qu'ils fussent, et il me semble que Vitruve a plutôt mentionné l'exception que la règle. Quant aux vases, si jamais l'on en a mis, il ne faudrait pas supposer qu'ils aient eu la forme d'une urne ou d'une amphore, mais bien d'un bassin d'airain, dans la forme des gongs Chinois, qui auraient été suspendus dans l'espace."

Mr. Edward Falkener, in a Supplement (p. 31) to the *Museum of Classical Antiquities*, 1854, (*see a Description of some important Theatres, &c., in Crete; from a MS. History of Candia, &c., by Onorio Belli in* 1586), has the following reference (see Illustrations Nos. 5 and 6):—

"The most remarkable feature, however, in these plans remains yet to be described. In three of these theatres we have one row, and in that of Lyctus (see Illustration No. 6) three rows of thirteen cells, for the harmonic vases; and, lest we should imagine that these vases are conjectural, we are distinctly told that the cells are clearly visible. On the plan of the large theatre at Gortyna (see, for this and the theatre at Hierapytna, Illustration No. 5) appear these words: 'Haveva tredici vasi di rame posti nelle sue celle che si vedono benissimo:' and Belli adds, that the common people call them ovens,—while in the description of that of Lyctus he says of the brazen vases, that almost all the cells are still visible. It will be seen that the number here shown (13) is that given by Vitruvius, and therefore the examples before us are of the highest interest as confirming the statement of the father of architecture relative to these evidences of the exquisite delicacy of perception of the ancient Greeks."

Conyngham, in his *Observations on the Description of the Theatre of Saguntum, as given by Emanuel Marti, Dean of Alicant* (see Transactions of the Royal Irish Academy, 1770, Vol. III, page 33), has the following reference:—

"I observed a peculiarity which is not taken notice of by the Dean. On the top of the principal præcinctio there are several grooves cut in the stone, of about 1 foot 6 inches broad, placed two and two at 2 feet asunder, and alternately between the vomitaria. This singularity surprized me; they do not appear large enough to support the bases for statues, and had they been intended for other ornaments, or for supporting rails, they would probably have been placed at lesser intervals. Might they not then be destined to receive the vases, mentioned by Vitruvius (si non erit ampla magnitudine theatrum, media altitudinis transversa regio designetur. Lib. v, cap. v), as necessary for increasing the sound of the voice, and which he directs to be placed in the middle of the height, which here exactly corresponds, the top of the præcinctio being 32 feet 9 inches from the orchestra, the probable half of the height when the outside wall was entire.

"It is to be observed, however, that Vitruvius directs thirteen cells at twelve equal distances, but here there are only nine, and it appeared to me that the intervals between the grooves were unequal. The skilful in these subjects will decide whether, by means of this inequality of the distances, the nine might not have answered the same purposes as the twelve at equal distances according to Vitruvius."

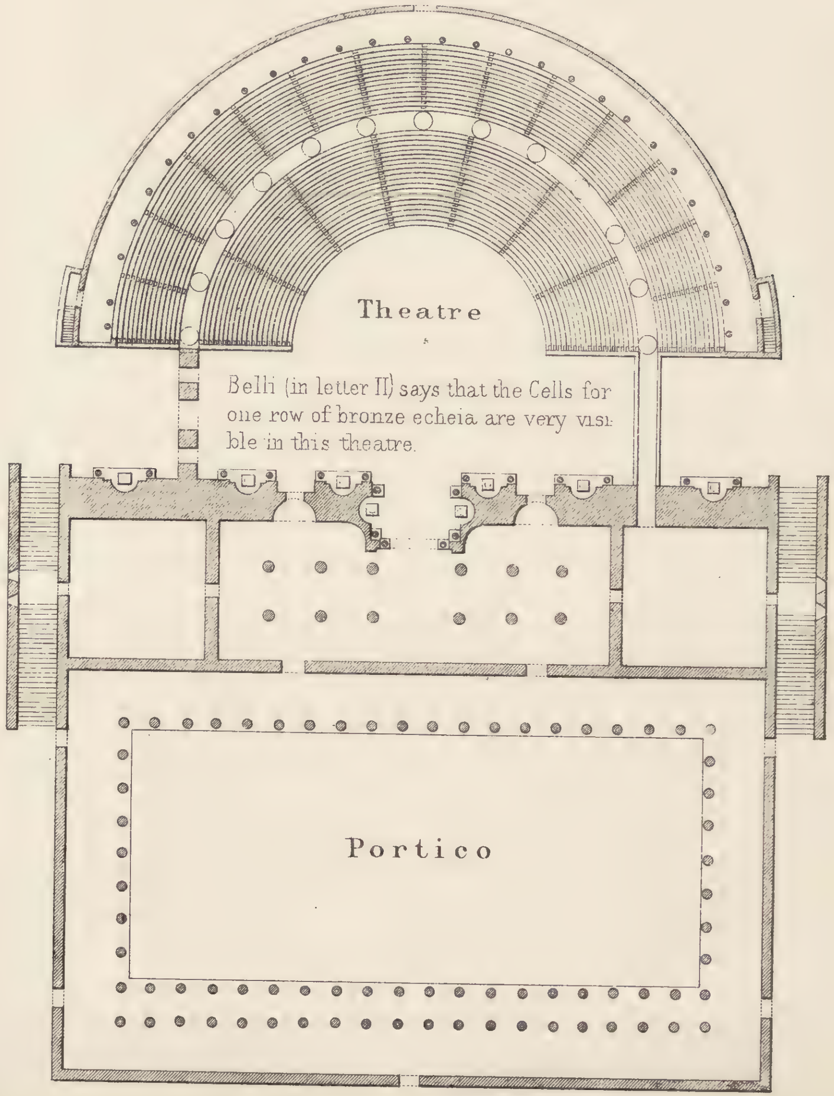
B.

Extracts from letters to Earl de Grey (then President of the Institute), dated Ripon, January and March, 1854, on the discoveries at Fountains Abbey, read at the Ordinary Meeting of the Royal Institute of British Architects, May, 29th, 1854, are here given:—

". . . . A screen once crossed the nave from pillar to pillar. In a space in the thickness of this screen a very curious discovery has been made, viz.: a number of large earthenware jars laid on their sides, and

APPENDIX (A) TO Mr. GORDON M. HILLS' PAPER (No. 5.)

The larger Theatre at Hierapytna
(restored as if perfect)



from an Original Drawing by Onorio Belli.
1582 - 1596

The larger Theatre at Gortyna.
(restored as if perfect)

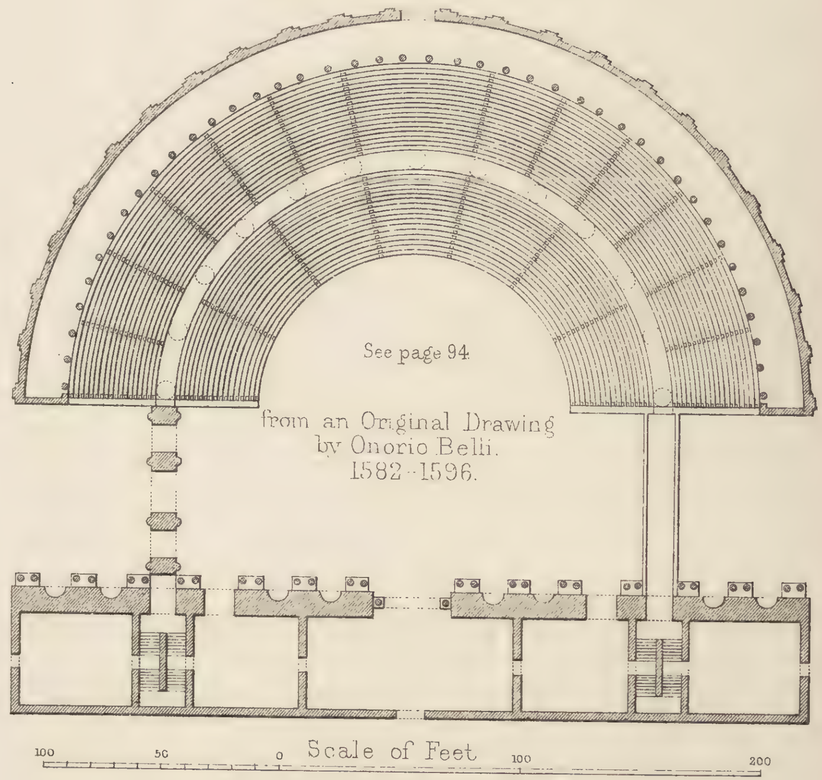
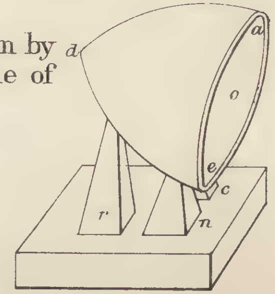


Diagram by M. Mautras of one of the Vases.

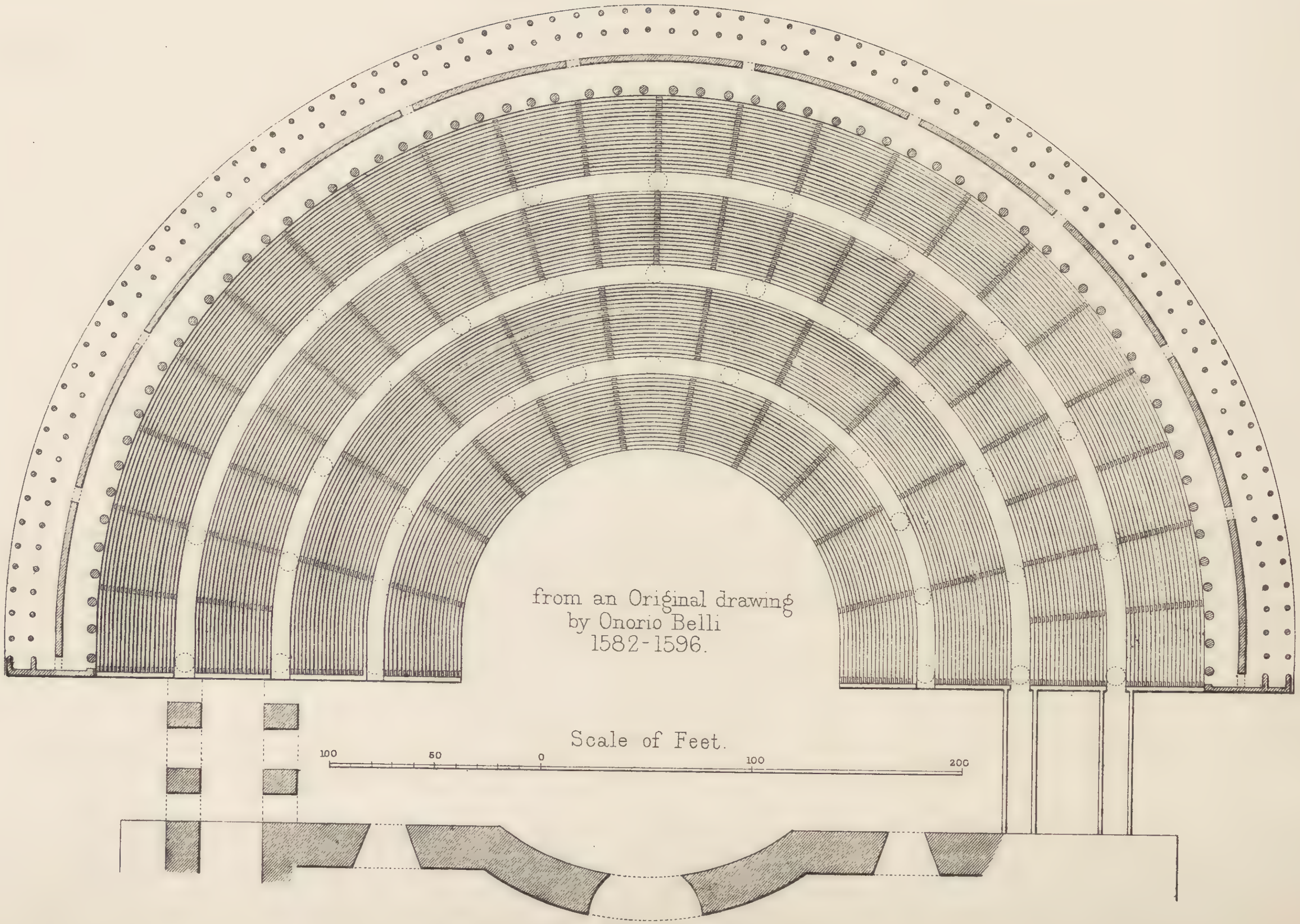


See page 89, Note 1.

C.F. Kell, Lith Castle St. Holborn, London E C

APPENDIX (A) TO Mr. GORDON M. HILLS' PAPER, (No. 6)

Note:-Belli (in letter II) says that almost all the cells for three rows of bronze echeia are still visible in this theatre, the largest in the island of Candia (Crete.)



Plan of the Theatre at Littus.

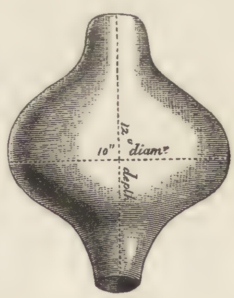
(restored as if perfect.)

C.F. Kell, Lith. Castle St. Holborn, London. E.C.

embedded in the base of the wall, a very few inches below the level of the floor. They were filled with charcoal ashes, but at present it has puzzled us all to discover their use. I hope shortly to be able to send a drawing of the place, and a correct sketch of one or more of the jars."

". . . . Captain Smith has favoured me with a perusal of your note respecting the singular rude vases or pots found at Fountains. The drawing (by Mr. H. W. Todd), the plan and the section herewith forwarded will, I trust, be found sufficiently explanatory of the position and appearance of these very curious objects. The wall in which the pots are deposited is, evidently, the base of a passage in the thickness of the old screen, which might be entered by a doorway in the side wall of the entrance through the screen; the floor being a step or two below the general level of the church. There is a small room in the thickness of the choir screen at Ripon Minster, on the north side—the similar space on the south side being occupied by the stone staircase leading to the organ loft. The screen in the church at Fountains not only crossed the nave from pillar to pillar, but it also occupied the space of the last arch of each *side aisle* of the nave. The pots or vases are laid in the wall on their sides, embedded in mortar. The depth of each vase is from 12 to 14 inches; the diameter across the widest part, 10 inches; the mouth 6 or 7 inches diameter. The necks of those in the west wall protruded slightly from the masonry; those in the north wall, when perfect, projected a little further. The presence of the charcoal in and around the vases will not, I fear, assist us in coming to any conclusion as to the real use of them. For the charcoal found here filled nearly the whole of the space No. 1 on the plan, and may have been the embers of the fires (fed by the stalls and other lattice work) when the lead was melted at the dissolution of the monastery. Charcoal was also observed on several parts of the floor of the nave. Cinders were also found *in very small quantities*, mixed with charcoal in large quantities, in the pots or near them. It may be well to remark that the whole of the depressed space in front of the wall in which the pots are embedded, was filled with charcoal. It is my opinion that the charcoal has nothing to do with the purpose or use to which the pots have been put. We know, from written record, that the lead from the roof at Fountains was melted into *pigs*, and the remains of a small furnace (*evidently post-reformation work*) were found, in making the recent excavations, attached to one of the pillars of the nave, *near* to the place where the pots were discovered. In fact, charcoal was found strewed in large and small quantities over the floor of the nave and transept. . . . . ."

Dr. Bromet, in a letter written in 1847 to the Hon. Secretary of the Institute, has the following reference:—



"In the Church of St. Martin, at Angers, in the walls and vaulting of its choir (which is said to have been built about the year 1020, and is of Romanesque architecture), are inserted several small vases, which the architects and antiquaries of Angers suppose to have been there placed with a view of increasing the sonorous property of this choir, in a similar way as the 'echeia' described by Vitruvius are said to have done. These vases, as I was informed (for I had not an opportunity of examining any one), are of amphora-like shape, 12 inches deep, 10 inches wide in the centre, and from 1 to 3 or 4 inches wide at top and bottom. They are of gray baked earth, and inserted at right angles in the thickness of the walls and vaulting, their mouths being flush with the faces of the said walls and vaulting, so that when seen from below they appear to be nothing more than small holes for the admission of air between the extrados of the vaulting and the roof. The vaulting of this choir is of two bays, each quadripartitely groined, and the vases are disposed in each compartment by threes in a triangular form, at the distance of some feet from one another; but as to the distribution of the vases in the side walls I cannot possibly speak,—the choir, when I inspected it, having been so full of fire-wood that I could only see one row of holes, about 4 or 5 feet apart. These vases are yet sound and sonorous, as I proved by getting up to some and inserting my walking-stick into them."

Didron the elder, in the *Annales Archéologiques*, 1862, has, in an article entitled "Poterie Acoustique," the following reference:—

"Ainsi, il n'y a plus aucun doute à conserver maintenant; tout scepticisme serait hors de saison. Le texte est précis : il y avait des pots et des cornets en terre cuite placés dans les murs de certaines églises, et ces poteries avaient positivement pour but de donner de la sonorité aux monuments. L'historien de la 'Chronique des Célestins de Metz' se moque agréablement du prieur Ode-le-Roy qui fit placer de ces engins acoustiques dans les murs de son église de Metz pour la grande fête de l'Assomption de l'année 1432; . . . . . S'il en est ainsi, nous savons maintenant qu'en Italie, en France, en Suède, en Danemark, en Russie, on se servait de

poteries creuses pour donner de la sonorité aux édifices ; nous pouvons donc affirmer, à peu près à coup sûr, qu'il en était de même en Angleterre, en Allemagne, en Espagne et en Grèce, c'est à dire dans l'Europe entière. Et cependant pour ce qui concerne la France, sauf les poteries de Saint-Blaise d'Arles et celles des Célestins de Metz, on n'a rien trouvé de pareil dans nos églises du moyen-âge, pas même dans nos immense cathédrales du XIII^e siècle, où c'était bien le cas, assurément, de leur donner toute la sonorité possible. Lorsqu'on sait ce que le moyen-âge a fait pour les cloches et pour les orgues, on a le droit de s'étonner qu'il ait négligé les poteries acoustiques, si c'était réellement un bon moyen de donner de la sonorité aux monuments. Mais j'ai dit plus haut que ce mode me semblait aussi puéril qu'inefficace, et c'est probablement la raison qui l'aura fait négliger. Les Messins s'en sont moqués et ont déclaré que c'était bon pour amuser les fous ; de là vraisemblablement son abandon par les gens sensés du moyen-âge. Cependant le grave Vitruve dit qu'on s'en servait dans les théâtres antiques ; on l'a employé, comme système, au moins en Suède, en Danemark et en Russie ; il y a donc lieu, pour les acousticiens, d'étudier la question, et pour les archéologues et les architectes, de rechercher si l'on ne trouverait pas de ces pots et cornets dans les murs et les voûtes de nos églises anciennes.

The only description given by Mandelgren of his illustration of the vault in Bjeresjoe Church is the following (see Illustration No. 1):—

"BBB indiquent la position des urnes dans la voussure ; elles sont sur cinq rangs, avec un intervalle de 45 centimètres entre chaque urne. Un rang est au milieu de la voussure, un à chaque pignon et un à chaque corniche de la voûte du couronnement. On peut conclure de la correspondance de leur position que ces urnes sont au nombre de 40 à 50."

The Abbé Cochet, at page 141 of *The Gentleman's Magazine*, 1863, has an article entitled "Acoustic Pottery," from which the following is an extract (see Illustration No. 2):—

"In 1862 the workmen engaged in pulling down the old church of St. Laurent-en-Caux (canton of Dondeville) were surprized to meet with a large earthen vase, of which the form was as remarkable as the position. This vase, placed in one of the angles of the choir, was entirely enveloped in mortar, and its form was that of a cone closed at each end. It had no other opening but a beak, which appeared in the form of a cornet at the surface of the wall. The exterior of the vase was furrowed with horizontal grooves. The form of the vase, and the earth of which it was composed, led me to ascribe it to the thirteenth century. I had remarked the same peculiarities of fabrication on vases of that epoch found at Leure, in the tomb of Pierre Berenguer, in 1856. I send here a representation of this strange vase (see Illustration No. 2), which is one of the most singular that I have ever seen. It is well suited for acoustic purposes, and appears quite unsuited for any other. The second acoustic vase that I shall mention came from the Abbey of Montivilliers (see Illustration No. 2), and is now preserved in the library of that city. It was taken from the vault of the choir under the tower of that royal monastery, and I conceive it was placed there at the rebuilding of the house in 1648 by the ladies of L'Hospital, abbesses of that establishment. I noticed also a dozen acoustic holes in the four angles of the clock-tower, of which the vault was ruined in the seventeenth century. I give here a representation of the vase, which is of an ash grey colour. Its height is thirty-four centimetres ; its opening is furnished with a neck-moulding, and the base terminates in a point. I conceive it to be of the same date as the vault, viz. 1648. The third vase that I have found, and of which I give an engraving (see Illustration No. 2), is one of the sixteenth century, discovered in the choir of the church of Fry (canton of Argueil). During the reparations there in 1858 four of these vases were found, two of which were in the sacristy. They appear to me culinary vases, which have been put to a monumental use. The height of the one here represented is thirty centimetres. Thus I have three times met with acoustic pottery, either in the choir or the nave of the churches of Upper Normandy. In 1852 I remarked, in the now destroyed church of Alvimare (canton of Fauville), circular holes in the prisms which surround the pillars of the choir and the clock-tower. These holes were nothing but the openings of earthen vases placed in the walls as agents of repercussion. In the church of Mont-aux-Malades, near Rouen, these vases fill the windows of the nave and the choir. These were found in 1842, when the Romanesque pilasters of the twelfth century were restored, but the acoustic operation appears to belong to the seventeenth. I have also observed these acoustic vases in the church of Contremoulins, near Fécamp, and in the ruins of the choir of Perruel, near Périers-sur-Andelle (arrondissement of Andelys)."

*** See for other references to this subject the article "Echeium" in the Dictionary of the Architectural Publication Society.

IV. NATIVE BUILDINGS ON THE GOLD COAST, WESTERN AFRICA.

By Major BALE (1st West India Regiment), *Associate.*

[Read on Monday, 5th December, 1881, T. Hayter Lewis, F.S.A., *Vice-President*, in the Chair.]

ALL NATIVE buildings on this coast, and far into the interior of the country, are necessarily built of the materials at hand. Those at Cape Coast (the town by Cape Coast Castle) have flat roofs, for catching rainwater, as no good water exists nearer than the "Sweet River," six miles off; but at the town of Elmina, two miles on the other side of this river, the native houses are for the most part thatched with palm leaves and branches, or with long grass, a coarse kind of hay. In the "bush" or interior the native "crooms" or villages are generally near a stream, but to secure rainwater without a flat roof, as thatch is there more available and suitable, the natives make round the exterior walls of the houses rainwater gutters of the fine clay of the interior part of the country, which they lay to a sufficient fall, and well puddle on the ground; this clay bakes hard in the sun, and whilst drying is made hard and smooth in the surface channel by rubbing with a split bamboo, till it has a glazed appearance, and with an occasional rub by way of repairs, it will resist the rains of a season.

The natural clay or mud of the ground is generally used for the walls, or the entire building as the case may be, with poles cut from the forest for floor and ceiling joists, placed without any kind of wall-plate; brush-wood is laid over these joists, and covered with clay rendered smooth and approximately level by rubbing, and it forms equally a floor or a roof,—for if unable to complete the house to two storeys the natives put bamboo or other rainwater shoots through the walls, and inhabit the lower rooms. For building purposes the soil of the locality, which at Cape Coast is a mixture of ferruginous clay and gravel, with granules of quartz and fragments of talc, with occasional masses of decomposed granite, is excavated and picked free from large fragments of stone, &c. by hand; mixed with water into a tough puddle called "swish," and made up into balls or masses, about 14 pounds weight, on the ground by females, nearly every labourer having the inevitable and inseparable baby on her back, carried in the folds of the "country cloth" or single garment they wrap about their bodies. The builders are men who receive the "swish" balls from the women, thrown by hand, which they catch and place with a jerk in the wall, and approximately square it with their fingers,—no scaffolding is needed, only a bamboo ladder. The sun soon dries the wall hard, and all cracks that occur are puttied-up with swish.

Here is a sketch* of a house in Cape Coast Town, built with the rudest materials, in the most primitive manner: much of the swish of the walls is discoloured with admixture of dirt from the surface soil, the floor joists appear through the wall to the outside, also some of the roof joists; pieces of board are inserted in the swish walls over the upper windows, and the top of the walls, or parapet surrounding the roof, is roughly protected from weather by pieces of board simply weighted down; all partition walls are carried-up from ground to roof, where they appear and divide the roof into sections.

* In the Institute Library, together with other sketches of similar houses by Major Bale.

In the building of these rude houses, it is a striking feature that they are well planned for native habits, fairly proportioned, and in elevation they have often a breadth of effect almost amounting to repose and dignity. Some of the oldest buildings have details such as cornice, door and window jambs, &c. in small "slack burned" bricks, size 6 in. by 3 in. by 2 in., commonly cemented together by swish, but in the better class of work (in some of the oldest houses) the lime used is made from burned shells; it sets hard and makes durable work in combination with these small bricks, which are kiln-burned. The kilns are usually about 10 feet in diameter, made with swish walls eighteen inches thick, and 5 to 6 inches high, open at top, and with a doorway about 2 feet wide. The flat roofs are frequently protected by a rendering of shell lime mortar, and the walls also, within and without in some of the better class of buildings, and if periodically limewhited, or coloured with the ochreous clays, the plaster is kept intact, and the walls are thereby preserved for an unlimited period. Most of the outer walls of swish houses are built with a batter* for the sake of stability, and protected from falling rain by an overhanging cornice. This shelter to the face of the walls is often omitted or imperfectly developed, and the damage by rain is repaired by slinging, from the thumb and finger of the hand, pieces of swish to fill up the parts worn away.

There is a composite class of hut built in the interior of the country, where the mud is tenacious and the clay fine and plastic; it is of more modern introduction or invention, but noticeable on account of the ingenuity of construction. First the frame of the hut, one storey high in all cases, is made of "bush-poles" joined by lashings of "tie-tie;" very long and tough withies, laths of split bamboo, are tied on horizontally inside and out of the framing. Similar laths are next interwoven horizontally, forming meshes about 4 to 6 inches square, and the space between is filled-in with rough stuff damped sufficiently to prevent its running-out through these meshes; the walls thus prepared are next rendered inside and out with fine clay plastered-on by hand, which is a trowel that feels the work whilst the eye directs it; the surface is next floated with bamboo floats and rubbed with them during the process of drying, till it has a highly polished surface. Grass or bamboo mats usually close the doorways and make blinds to the windows, but where talc is found in flakes of sufficient size, the natives employ it in lieu of window glass. The roof is made of bush-poles propped-up along the ridge from the floor inside, and thatched with palm branches or grass. Sometimes a clay chimney is provided in the gable walls of these huts.

The earliest authentic records of the Gold Coast (quoted by Cruikshank, Bowditch and others) prove that the first European explorers were the Portuguese. In 1412-18 Prince Henry, son of King Joam, traced the coast as far as Cape Bojador, and in 1433 obtained of the Pope a grant to Portugal of all lands or islands between Bojador and the East Indies; some English in the reign of Edward IV were stopped by virtue of this bull. King Joam II, in 1481, sent an expedition of 500 soldiers and 200 labourers under Don Diego d'Azambaja, and landed at Elmina on the Gold Coast, and there built the fortress of St. George and established other

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* This batter has partly induced Major Bale to see in the swish houses in the neighbourhood of the Gold Coast a resemblance, in their general effect, to the smaller buildings of the ancient Egyptians. It may therefore be worth while to allude to Professor Donaldson's description of the mud-built houses of the Fellahs (TRANSACTIONS, 1860-61, p. 194) and to other references on the subject of the unchangeable nature of Egyptian village building in Professor Lewis's Paper (TRANSACTIONS, 1875-76, pp. 31-34).

fortified settlements. By their example and aid the natives built a town under shelter of the castle, the walls being for the first time on record built in random rubble, in imitation of the manner and materials of the castle walls, but for the most part cemented only with mud. Thus the natives improved their dwellings and they copied much architectural detail from the Portuguese buildings, using burnt shell lime in building, and adopting wooden doors and jalousies for window openings. The value of shell lime is proven by the durability of the oldest European-built forts on the coast; the walls of these forts are of random rubble stone and mortar made of burned shells and sharp sand in equal proportions. Bricks (imported) were used in making up architectural details, the whole walls being rendered in rough stucco, and lime-whited, or coloured with some of the ochreous clays, to preserve them from weather, and the flat roof so rendered was used successfully by the Portuguese. Many architectural features are of Moorish type, especially the arches to arcades of verandahs to houses. The ogee arch, very depressed, built in native bricks, radiating from a common centre, is frequently met-with; the same is remarked in the woodwork pattern of doors, which are far better attempts at joinery than anything the natives can now do in panelled doors.

The jewellery in gold ornaments paid as part indemnity for the war of 1873-74, and the 2000 ounces handed to Sir Samuel Rowe, the Governor of the Gold Coast, by the King of Ashantee, contained a few original old pieces of Portuguese workmanship, and much of the native work was a close imitation of it, a proof of the educational influence of the Portuguese occupation of the country.

The Dutch drove the Portuguese out of Elmina in 1637, and the lesser forts soon after fell to them; they taught the people nothing new in buildings, but encouraged them to improve the comfort of their dwellings, and the appearance of their towns, by planting rows of trees along the streets, keeping them in good order, and annually colouring or lime-whiting their houses. The English in 1662 chartered a company under the Duke of York (afterwards James II) for trading on the Gold Coast, and Cape Coast Castle was taken from the Dutch, and other forts were built to protect trade; the Danes and the French acquired trading stations, on the coast and members of all these nationalities vigorously prosecuted the slave trade in the last and beginning of this century.

At the present time, the natives generally have not the remotest idea of a truss for a roof, or the most simple expedients in building; they have, however, lately copied the traders in using corrugated iron for roofs, even on the top of mud walls, though the eaves gutters fall the wrong way for the current, and the downfall pipes are in every possible degree out of the perpendicular. Yet these people were capable of learning long ago, and now quickly read a plan or working drawing, and know the meaning of the scale, after a little teaching. If shown a new way of building they imitate it at once, as far as shown, but they do not comprehend the principle readily, and when left to themselves make blunders that appear like perverted ingenuity rather than stupidity.

V. THE LATE MAJOR MANT, R.E., *Fellow*. By R. Phené Spiers, *Fellow*.

[Read on Monday, 5th December, 1881, T. Hayter Lewis, F.S.A., *Vice-President*, in the Chair.]

THE WORKS designed and carried-out by the late Major Mant are of so special and important a character that I have thought some notice of them, illustrated by photographs and drawings, might not be without interest to his architect colleagues. Unfortunately, I have never seen any of the actual buildings, and am only able to describe them from the drawings. I hope, however, that some of Major Mant's friends who are here present this evening, and acquainted with the works in question, will be able to add to my notice.

The late Major Mant joined the service in 1857, being then about nineteen years of age. He went to India in the latter part of 1859, rising to the rank of Captain in 1869, and to that of Major in 1874, having meanwhile passed through the various steps of Assistant and Executive Engineer in the several grades. He was elected a Fellow of the Institute in May last, being the first Royal Engineer who has ever been admitted to our Society in that class.

The first work to which his name is attached is that of the High School of Surat, an Italian Gothic building, erected at a cost of £2,500. This, and the Town Hall of Kolapore, built in 1872, show his early tendencies to work of the Gothic school. About the middle of this year his attention would appear to have been turned to the study of the indigenous buildings of the country, for within the next two years the following works were carried-out from his designs: the Court-house and High School at Bhownuggur, erected at a cost of about £9,000 each; the High School at Kolapore, at a cost of £35,000; and a monument at Florence to the memory of the Rajah of Kolapore; all in the Hindu-Saracenic style. The working drawings for two of these buildings were prepared here in England, during an extension of furlough which he obtained till December, 1874. It could scarcely be expected that in so short a period Major Mant could have mastered so complicated and ornate a style as that in which these buildings were designed, if he had not had the good sense to avail himself of the native talent of the country. Fairly conversant with the Hindustani and Urdu dialects, in which he had passed examinations in the higher standard of proficiency in 1868, he engaged and trained native draughtsmen to work out his designs. The plans and the general scheme of the design were his own; the ornamental details were worked out by these native artists from his sketches and photographs. The buildings were of course of a totally different class from that from which he derived his inspirations, but he managed to adapt the various features so well and with so much ability that it led to an extensive practice. He was fortunate enough towards the close of 1874 to attract the attention of Sir Richard Temple, then Lieutenant-Governor of Bengal, who not only was a great admirer and connoisseur of the ancient Indian temples, but warmly appreciated the efforts which Major (then Captain) Mant was making to reproduce the style in his own designs. By his influence, Major Mant's services were transferred to the Presidency of Bengal, and subsequently, when Sir Richard Temple became Governor of Bombay, he followed his patron there. In 1877 he was appointed Director of the School of Art in the temporary absence of Mr. Griffiths, the well-known painter of Indian life, and in the same year Superintendent of the Antiquarian Remains of India. His next design, made on his return to India in the commencement

of 1875, the Cooch Behar Palace, was never carried-out, the works being stopped for financial reasons. In the same year he designed and carried-out a college at Dacca, at a cost of about £10,000. In 1876 he erected two small churches at Balasore and Chupra, and a hall at Dacca, named after Lord Northbrook, and in the same year a college at Ajmere, named after Lord Mayo; the first design for the latter had been originally prepared in 1875, but abandoned on account of its expense. The hospital and library at Baroda, erected at a cost of about £30,000, also belong to this year's work. In 1877 he designed and carried-out a medical school at Patna, named after Sir Richard Temple, Bart., at a cost of about £6,000; the Normal Training and Vernacular School at Cooch Behar, at a cost of about £10,000; the Mitford Hospital, and other works.

In 1878 he commenced the hospital at Kolapore, and the Junagarh High School, their cost being £27,000 and £15,000 respectively. In 1879, 1880 and 1881, a church at Malabar Hill, Bombay; bridge and town gate at Baroda; the Deoghur block and the Mudhal Palace, built for a hill chieftain in the Gujerat Domestic style, were amongst his important works. His three chief works, however, (two of which I am able to illustrate more in detail this evening), are the palaces for the Guicowar of Baroda, for the Rajah of Kolapore, and for the Maharajah of Durbhanga. The design for the latter was not terminated at the time of his death, and therefore I have not thought it worth while to produce more than the first sketch. Its estimated cost was £160,000.

The palace at Baroda, about 200 miles north of Bombay, which is now being carried-out at an estimated cost of £200,000, covers about 130,000 square feet, the principal part, facing the west, being 520 feet in length. The accommodation in this palace may be divided into three sections: the centre section or block containing the residence of the Guicowar, his guards and suite; the block on the left or north side, the Durbar hall, or grand assembly room; and the block on the right, the Zenana, containing the separate residences of the Ranee and the Guicowar's mother. The main walls are of brick faced with a vitreous sandstone obtained from quarries in the neighbourhood. The strings and cornices are in stone of two colours, blue and yellow. A fine sandstone is being employed for the capitals of columns, and it was proposed to use marble for the domes and for the linings of the principal apartments. In consequence of the difficulty of transport, it was proposed to use teak-wood for the beams and joists instead of iron, all of which would have had to be sent out from England. At the time of his death, however, estimates were being obtained for iron and fireproof floors throughout. Thin slabs of stone or tiles were proposed to be laid on the joists, and concrete or earth on these to form a floor, that being the usual method of forming floors in the country. The earth is well rammed down, and is preferred by the natives, being soft and cool; in the principal rooms it is of course covered with carpets. In the main corridors cement or tiles, and in some cases marble, would have formed the surface. The roofs, excepting over the Durbar hall and staircases, were all flat, the concrete being covered with asphalte. The Kolapore Palace, the estimate for which is £60,000, is smaller than that of Baroda, and covers a site of a little over 100,000 square feet. It is nearly square in plan, and contains similar accommodation to that described in the Baroda Palace: that is to say, the entrance for the Rajah is in the centre, with his suite of apartments chiefly on the first floor; the Durbar hall occupies the left-hand side of the front

block; the Ranee's apartments the right-hand side. The principal buildings from which Major Mant seems to have derived his inspiration are those in the Hindu-Saracenic style around Agra, the chief being at Bhurtpore, Muttra, Deeg and the neighbourhood. The Jain temples of Ahmedabad, and other buildings in Gujerat, afforded him also many suggestions.

In regard to the circumstances of his death it was said that his temporary insanity was due to a belief that there were errors in his plans and designs which would have led to his professional ruin. This was, however, not the whole case. He had, when in India, been accustomed to invest in various speculations, and on his visit to England on leave, he would seem to have continued that practice. His constitution, however, would not stand it, and he frequently complained of the many sleepless nights he passed. I did not know then that it was probably in consequence of the excitement and worry caused by his successes or reverses. About the beginning of August, the failure of a tower constructed by one of his contractors (but with the design or execution of which he had had nothing to do) led him to examine a similar feature in his own design; and he discovered that, owing to the treacherous nature of his foundations, loose sand, and the mixed construction in brick and stone of some of the piers of his principal elevation, there were weak points which required attention. As the building had only been carried-up about five or six feet above ground, there was ample time to correct this; by my advice he obtained the services of a professional engineer, and on his report, which accorded with Major Mant's own calculations, alterations of various kinds were made, and revized tracings were sent out; the probable cost of such alterations would not have exceeded £1,000, which, in a palace estimated to cost £200,000, was inappreciable. The discovery, however, came at a time when he was suffering from great losses. In the disturbed state of his mind, he magnified every molehill into a mountain, and determined to go out to India to superintend the alterations in person. The disease, however, was too far gone, and disappointed by the non-arrival of a letter containing funds for his travelling expenses, he put an end to his life. Subsequent letters from India have shown that before he left India he had himself foreseen many of the weak points, and left directions as to their revision. His loss is a very great one. It is only nine years since he carried out his first building in the vernacular style of the country, and the cost of the works carried out or in progress from his designs exceeds three-quarters of a million. It is probable, therefore, that being only forty-two years of age at his death, he was on the threshold of a brilliant career. He possessed the character with his patrons and amongst his brother officers of not only being highly distinguished in his attainments, but being perfectly straightforward and upright in all his transactions. I had the opportunity during the last month of his life, when I saw him nearly every day, of studying his personal character. This was at a time when he was under the shadow of his reverses, and his anxiety was not for himself, but for his wife and children, his assistants and his patrons. There is no doubt that the intensity of this anxiety led to the temporary derangement of his mind, for he was well aware that could he have lived another year his losses would have been recouped.

MAJOR MORANT, R.E., *Hon. Associate.*—Mr. Chairman and Gentlemen, being a brother officer of Major Mant, and having been at college and in India with him, I beg to offer a few

remarks. I wish to thank Mr. Spiers for the generous way in which he has alluded to my late friend. I do not think his picture at all too highly coloured. It is extremely encouraging to officers who are working in the Art in India to receive, at the hands of an Institution like this, so generous a recognition of any little service they may have been able to perform. I have not had the privilege of seeing any of Major Mant's buildings, except the Surat High School, but there is no doubt that they have been extremely successful. I am glad to observe that Major Mant changed his style from European Gothic which was, to a certain extent, unsuited to India, to the styles of the architecture found in the country itself. I think that in considering what style of architecture is best suited for India, it is well for an architect to adopt a style that is already indigenous to the country, and of which we have such excellent examples by both Hindu and Mohammedan architects. It is a mistake, I venture to think, to transport your Gothic—or any other European style, produced in and suited to a cold climate—to a place like India, where the climate requires a very different style of architecture altogether. The Indian styles of architecture, so far as I have seen them, appear very suitable for domestic buildings; and both Major Mant and other architects have adapted them so as to make very convenient buildings out of them. The Hindus and Mohammedans are extremely lavish in all their methods of ornamentation, and of course in the hands of a European architect it is necessary to cut them down, and make them more suited to the economical conditions of the country, and of our century. The conditions under which architects in India work are extremely different to those in which architects practise at home. An architect in England devotes almost the whole of his time to designing his buildings, and to drawing out the proper details. The execution of the work is generally, I believe, left to builders and contractors, and those who supplement their labours,—whereas in India an architect has nearly the whole of the work upon his hands. He has not only to design his building but also to frame its estimates, and see its erection carried-out. He has very often to make his own bricks, procure his own timber, and act as a sort of contractor under himself. This method has doubtless advantages of its own, and necessarily enables the architect to obtain a more intimate knowledge of the details of his work; but it has its drawbacks. Regarding one of the details mentioned in the Paper, I may say that flat roofs are very common, and in forming them it is usual to place three courses of flat tiles breaking joint upon the concrete of the roof, covering the tiles with a coat of polished cement. Where this is done, I believe, flat roofs answer very well; but they only answer under certain conditions of climate. When the rainfall is extremely heavy and comes down in a short time, and when a burning sun succeeds and rapidly dries-up the surface of the roof, such flat roofs answer well; but in moister places, where there is a constant soaking rain continuing for days, the water eventually soaks through the roof from which it cannot pass off rapidly, and drops into the rooms below. Attempts have been made to omit the three courses of flat tiles, and to use a thicker layer of concrete, but such roofs do not succeed. I may say in conclusion that there is a very great opening for architects in India, and that the country offers a vast field for their efforts.

Sir RICHARD TEMPLE, Bart., G.C.S.I.—Mr. Chairman and Gentlemen, I have the greatest pleasure in appearing before you this evening to bear testimony not only to Major Mant's qualifications as an architect, but also to his qualities as a man, and as a public officer. As for their being any mistakes or errors, or shortcomings in his designs, I for one do not believe

a word of it. I am certain that a more talented, accomplished and conscientious engineer never existed in India. Gentlemen, his career forms an important episode in the history of architecture and engineering in India. I may mention that whereas we British people in India inherited from our native predecessors a very fine architectural system, yet we went on for nearly a century in building structures which, instead of having a civilizing effect on our native subjects, had, I must say, a barbarizing, demoralizing and debasing effect. During the last generation we seemed to have awakened to our failings in this respect, and at last we have begun to build structures which in some degree are worthy of a civilized Government. At most of the capital cities we have produced architects of some fame and position. I would mention the late Mr. Granville of Calcutta, Mr. Chisholm particularly in Madras, and in Bombay Major Wilkins, Major Fuller, and more particularly our lamented friend, Major Mant. One cause of our architecture (British Anglo-Indian architecture) being so inferior is, I venture to think, the fact that there never has been any proper technical education in architecture among our military and civil engineers. I mention this fact in the presence of many great authorities; but as an unprofessional man I believe that to be the case. I do not wish to disparage the taste or skill of our British engineers in India, and as to their science, I believe that no engineers in the world, or any country or age, have done better work than they have in India. I am sure that our public works generally are among the grandest monuments of British rule in the East. Nevertheless artistic taste has not as yet (it is no good saying that it has) characterized our buildings in India. With some grand exceptions, most of our structures in India are plain, ugly and uncivilising in the extreme. While we had men among us like Major Mant there was a chance of our improving in this respect, and therefore it is that I think his loss is almost irreparable—I will not say perhaps quite irreparable, but difficult to repair. You may ask why, if the native architecture is so extremely good we should not follow it absolutely—follow it pure and simple—in our Anglo-Indian structures. Well, gentlemen, there is this particular reason: If you are to construct buildings which are perfect in respect of utility and convenience, then you must call in the aid of European science. It may seem strange to say it, but it is in respect of taste and imagination, and of everything that relates to beauty and stability, and to æsthetic culture (I do not use that word in its present debased sense, but I use it in its high and true sense)—I say it is in æsthetic culture, most strange to say, that the natives of India so surpass us. If you, gentlemen, you British architects, wish to have your taste refined, your imagination elevated and your thoughts raised, I would recommend you to visit the localities mentioned in Mr. Spiers's interesting notice—namely, Agra, Delhi, Bhurtpore. But, gentlemen, as regards Major Mant's architectural designs, his distinguishing merit probably was this: that whereas some of his architectural and artistic predecessors transplanted European styles bodily into India, endeavoured to naturalize the Gothic styles for instance as an unhappy exotic in that eastern soil, he tried instead to hit on some style which should unite the usefulness of the scientific European designs together with the beauty, taste, grandeur and sublimity of the native style; and this style he called the Hindu-Saracenic. From the interesting drawings, too, around the room, to which Mr. Spiers so judiciously alluded, you will have observed that he gradually arrived at that conclusion, and towards the end of his too-short life he was beginning to frame designs which I venture

to think combined the merits both of European science and of native art. Then perhaps I may say that the defect yet remaining in Major Mant's designs was that there was some want of simplicity and grandeur in them as compared to the native designs. You will be able to judge for yourselves. The drawings are present here to-night, and you will be able to judge for yourselves as to whether my remark is correct or not, but I think even to the end they were a little too much overlaid with details, and a little wanting in grand striking features. I suppose it is the case with all buildings in all countries, but it is the case in India, that if you are to have striking designs they must have very prominent features. If there are spires or pinnacles there must be some spire which is quite monarch of them all; if there are domes there must be domes or cupolas of a lesser size, domes of a middle size, and there must be some grand dome prominent over them all, that shall be a landmark from afar. If there is to be a certain number of towers, then there must be one tower which soars aloft and to which other towers are subsidiary—secondary and satellites as it were. These subjects I often had the pleasure of talking over with Major Mant, and these views, as you may imagine, I very much pressed on him in conversation. As regards native architecture, I venture to think that members of this Institute could hardly do better than take the earliest opportunity of visiting that most interesting country. There is not only one style, but many styles. There are the Buddhist and the ancient Hindu styles, and the modern Hindu style, and above all there are the Mohammedan styles. Now these styles are perhaps ten or twelve in number, but Mohammedan art culminated with that line of emperors, who are popularly known in England as the Great Moguls. The Great Mogul (I speak of him generically) was the greatest architectural genius that ever lived I believe, not excepting the ancient Greeks, and not excepting any modern nation whatsoever. The buildings which he erected are still the peerless structures of the world, and if you have any doubt you have only to make the trip (it is very easily made now-a-days), and judge for yourselves. You will find that whatever ideas you may have formed about marble structures and Milan Cathedral, they will all pale their ineffectual light before the beauty of some of those structures at Agra. It is a very happy circumstance for architecture and art in India, that this influential meeting has been held this evening here at the Royal Institute of British Architects. I am sure you could not have done better than attend so largely on this occasion, because you are interested in art, the high art as applied to this most important department—namely, architecture. Here was a man in Major Mant, who was, gentlemen, a genius in your profession, a born genius, because, recollect, he was not brought up as an architect, but first as a military and then a civil engineer. Therefore, though he had none of the many professional advantages which you enjoy, yet he had genius inborn, and he had also the advantage of seeing the glorious, the inspiring models which India affords. His loss, as I said at the outset, is almost irreparable, though certainly it can be repaired, but it cannot be repaired at all, I am certain, from the resources available to the Government of India itself. Therefore I hope, if this high and noble work which Major Mant began, and his fellow-labourers also began, is to be properly carried-on, that the Government will go to the fountain head—the right source—and get some of the very best men from this Institute of Architects in London. I will not trouble you further now, but I hope that, with the permission of the Chairman, I may be followed by the very distinguished Officer of Engineers

who is present this evening—namely, Sir Andrew Clarke, because he has held, as you may be aware, the very important office of Minister of Public Works in British India. He has therefore had more intimate contact with all these great works and designs than I could possibly have, who was after all mainly a political administrator; and he will speak on these subjects with much more authority than any authority to which I can pretend. If there be any professional mistakes in the remarks I have made he will explain them to you, and rectify them; and I am certain that, even if I am correct in what I have said, he will be able to add many interesting observations of his own.

Colonel Sir ANDREW CLARKE, C.B., K.C.M.G.—I feel, following so able a speaker as Sir Richard Temple, and unprepared as I am, that I shall be somewhat at a disadvantage. But I must put a lance in rest on behalf of my brother engineers and architects in India, both civil and military, and say, that if their genius has been clipped, it has been too often clipped by the scissors of my hon. and right hon. friends the Finance Ministers, one of whom has now become our critic. When I see in that corner an illustration of Major Mant's greatest work —what I think will prove to be my dear friend's greatest work—and one which, when completed, would have been indeed a gem, the college for native princes at Ajmere, I am reminded that, when those designs first came to me from Major Mant, I used the whole of the authority that I could exercise with the Government of India, in order that that great and beautiful work should be carried-out in its entirety. But the "attenuated" rupee was thrust in my face, and this elevation was cut down, and that detail omitted, whilst the prominent feature to which my hon. friend just now alluded so eloquently in describing what architecture should be—the great tower in connection with that very college—was ruthlessly struck off by the finance authority of the day. I may say that on that particular occasion it was *not* my hon. friend Sir Richard Temple. And now having said these few words with reference to the difficulties which beset a man of genius carrying-out his own designs in India (and I can quite fancy that I have the sympathy of everybody who tries to carry-out his own designs in this country) I may add that architecture received at the hands of Sir Richard Temple an impetus in India which I hope is now lasting. And I am glad, at the same time, to say, that although no one deplored and regretted the premature death of Major Mant more than I did, esteeming him as a friend, and admiring his great talents—talents which have already had their beneficial influence on public taste in India, and which I trust will yet lead to a larger-hearted and more liberal recognition of the fact that the beautiful can be blended with the useful—yet there are one or two men in India upon whom it may be said his mantle has fallen. I allude to one—I do not know whether he is known to any of you—Mr. de Fabeck, of Central India, who has produced one or two beautiful works. I may also name a young officer who, I think, bids fair to make a mark on Indian architecture, and that is Captain Cole, son of Sir Henry Cole, and there are others,* so that in this direction I believe we may have hope for the future. I cannot agree with all that was said about native art, for I am afraid the time is very far distant when we can depend upon having any assistance from native architects in India. The truth of the matter really is that, as far as all my investigations went in India, those great works, comparatively recent works, which have been handed down to us, and to which

* Mr. Chisholm, of Madras, for instance, who is a Fellow of the Institute, and well known for many years in different parts of India.

Sir Richard Temple so forcibly and eloquently alluded, are really the work of European architects, and not the work of native architects. Around Agra at this moment can be seen the tombstones of numbers of Italians who were employed at the time alluded-to either in carrying-out the details or, as I personally believe, in the conception of the original ideas themselves. India has had a golden age of architecture, but it was of an age long anterior to the period now spoken-of, and has left little but its ruins, for its spirit is dead. In working-out details, and the manipulation afterwards of work, no doubt the Indian native is a thoroughly conscientious and painstaking labourer, but he requires direction, and he requires also that the design shall be furnished. He is more of a copyist than an inventor. With reference to another industry which Major Mant has largely influenced in India, I would remind you that he devoted much attention to the working of the native marbles, and their introduction into his designs. This was particularly the case at Ajmere, which work has been conscientiously carried-out by one whose name will probably be familiar to some of you—Mr. Brassington, who has revived and developed the use of the beautiful and almost unequalled marbles of Rajpootanah, in constructing the Mayo College.* I hope that we shall see some of these marbles introduced into this country, because they are comparatively cheap to work, and their carriage by rail and sea will not now be excessive. I take, I may say in conclusion, a more hopeful view of the growth of architecture than most people, although I thoroughly endorse what Sir Richard Temple has said as to the meanness of much of our modern Indian architecture in the past. There are a few exceptions, as, for example, some in the earlier part of this century and the end of the last, when our English engineers left us one or two works which are fairly decent. No doubt it is painful to go into some of the old forts of the Mogul dynasty, surrounded by the most beautiful buildings, and see the contrast with the "hideous," "ugly" and "demoralizing" buildings to which my hon. friend has alluded; but these latter are the creation of the administration rather than of the architect. Educate and elevate the taste of the former, and there soon will be found in India, as elsewhere, able and gifted agents to give it form and expression.

Surgeon-General Sir JOSEPH FAYRER, M.D., K.C.S.I., F.R.S.—When I received an invitation to come here this evening I accepted it gratefully, because I knew I should hear something that would interest me deeply, and that I should have the opportunity of learning much. It would be absolutely presumptuous in me to attempt to speak upon architecture, of which I know nothing, though I have seen and admired those works and buildings about Agra, Delhi, Muttra, Deeg, and in the south and elsewhere, which have been described by Sir Richard Temple and Sir Andrew Clarke. I had not the pleasure of knowing the late Major Mant personally, but I had heard and knew something of his natural genius. It has been very agreeable to hear such testimony borne to his character, and the merits of his work; and it was touching to hear the account that was given of his end—an end that was brought about, no doubt, as a consequence of the effects of climate and of overwork, which tell so heavily, and cause such mental and physical strain, as to prostrate many of our countrymen in India. I think, Sir, that you are to be congratulated on having two such speakers here as Sir Richard Temple and Sir Andrew Clarke, both entitled to be heard on the subject of Indian architecture. Sir Richard Temple, who has administered so much in

* See Appendix C.

India, who has ruled I suppose more than a hundred millions of people in his time, and who, as we know, has ruled them well, has been steadily, throughout the whole of his career, a supporter and nourisher of art and genius. I believe no one has done more for India in respect to art and architecture than he; an artist himself he thoroughly appreciates art, and has well used his opportunities of encouraging it. I cannot venture to offer any opinion on the buildings that you have displayed in the plans before us, but it is pleasant to see by them that a movement has commenced in India in native styles of building. I do not know whether Sir Richard Temple was alluding to the comparatively new buildings in Bombay when he spoke of Gothic architecture, but I suppose he was. It would be a great heresy to find fault with them, but surely they are not so well adapted to a tropical climate as the style adopted by Major Mant, which resembles the native style; for no doubt the Mohammedans, who made domes and flat thick concrete roofs, had a very good notion that they would have the effect of keeping out the heat, and rendering the houses cool.

Mr. WILLIAM SMITH, C.E.—I feel it incumbent on me to rise and say a few words with reference to one of Major Mant's works. I am no longer connected with the Government of India, and after leaving its service I was professionally employed for a while at Cooch Behar. During that period I had the opportunity of seeing some of Major Mant's designs carried into execution, and I beg to say that, travel as one may over the greater part of Bengal, one will not find a much handsomer or more appropriate building than the Vernacular School which was completed there at the beginning of this year. It cost £5000 to build, and it will ever remain an appropriate monument to Major Mant's memory.

The CHAIRMAN.—It becomes now my pleasing duty to move from this chair a vote of thanks to Major Bale and to Mr. Spiers, and, in addition, to those gentlemen who have favoured us with their valuable observations this evening. We had hoped that one of our members, Mr. Fergusson, who has a European reputation for his knowledge of India, and Mr. Emerson, who also is well acquainted with Indian architecture, would have been present, but Mr. Fergusson has written regretting his inability to be here to-night. Mr. Spiers has introduced a subject on which very few of our colleagues can take part from personal knowledge, inasmuch as not many of them have been to India. The observations which Major Morant has made with respect to the way in which works in India are carried-out under the direct superintendence of engineers reminds one of the way in which mediæval works were carried-out. I can well understand that the description Major Morant gave of architectural work in India would apply pretty much to any mediæval architect engaged on any particularly great work. Sir Richard Temple's description of the method of designing and its chief features is most valuable. His sketch of the way in which one subject should be subordinated to another, and the general way in which the whole should lead-up to the most important object is what we would wish to do, and we can only hope that architects in general will be rather better placed in reference to patrons than Major Mant was in respect to his design for the college at Ajmere, in which I believe the chief feature was eliminated, though *not* by Sir Richard Temple. I have not been in India, and I will not therefore attempt to give any opinion as to the details of these buildings, but there is no question of the general merit of the designs. I am sure we shall all have the kindliest feelings for a man who has done a great architectural work, whether he be a civil or a military member of the profession. His designs, certainly, are extremely picturesque, and

in spite of Sir Richard Temple's doubts I cannot but think that there are grand features in the outline of that work at Baroda. As to buildings now to be erected in India, the great point seems to me to depend on whether they are to be in the native styles, or whether they are to be such as would be recognized as of our own country. I dare say Sir Richard Temple will remember that some years since Lord Napier broached this question—I think before the Society of Arts. He then strongly advocated the exclusive adoption of native styles of architecture in India by the English. It happened that a few days ago I had a letter from Peshawur, from a gentleman concerned in the building of a proposed church there, and he writes me appositely to the present purposes, as follows:—

"Our reasons for wishing to build on Oriental lines arise from the fact that Afghans, amongst whom we work, dislike English manners and customs, and there is less difficulty in getting a bigoted people into a Christian place of worship, built after Eastern ideas. . . . . Some of their buildings are very handsome, and it should be our object, as much as possible, to conform to their ways and habits of thought, so long as we yield no principles."

This bears out, no doubt, what gentlemen have just said, but I think that it is worth while to give some attention to the opposite side of the question. It is one which very much affects architects, whether civil or military, because I apprehend that if we are to have a style of architecture in India, based entirely upon the native arts, it would require a training and a close study of the styles in India itself. For if any man were to base his practice simply on Indian models and drawings, or from the study of books, he would fall into as great difficulty, and produce just as bad works as an architect who would attempt to build a large Gothic edifice simply from studying Gothic books, instead of doing as we do now—going amongst the works, sketching them, understanding exactly the principles and details, and making ourselves masters of the principles, and not simply of the outlines. I apprehend, therefore, that if we are to have the native style of architecture followed, it would require that the architects should have a considerable training in India, which would lead of course to a considerable alteration in our general practice and studies. I will only say one thing more with respect to that particular subject of building entirely in the native styles. We all know perfectly well what a pleasure it is in going into a strange country, without even Murray's Guide Book, coming to an old ruin, or a building not a ruin, but which is old, and being able to pick out the exact people who reared it, to know who they were, and the time at which it was done. You can do it, in general, by the architectural handwriting on the stones, by the carvings and mouldings, and general styles, as if the inscription were written in so many letters. It has been always so in ancient and mediæval times, with the grand exception of Egypt, viz., that wherever a nation has conquered or colonized, those who have come have taken with them not only their religion, their habits and their customs, but their peculiar phase of art. They could be distinguished by their art, as they could be by their language. I merely suggest as a subject worthy of more attention than it has received, and I do not say that India may not be an exception, that we, being the greatest of colonizers now, and the greatest colonizers as I believe that the world ever saw, will, if this principle be accepted of entirely conforming to native arts and habits, be an exception to that grand rule which I have mentioned, and which has produced such delightful means of study to the learned in every art.

APPENDIX C.

Royal Engineers Institute, Chatham, 10 *December,* 1881.

Dear Sirs,—Colonel Sir Andrew Clarke has asked me to send you the inclosed copy of an extract from the Specification of Mayo College at Ajmere, designed by the late Major C. Mant, R.E., as he thinks it may be of interest to your Institute.

I am, &c., Robt. H. Vetch, *Major R.E. and Secretary R.E.I.*

The Secretaries: Royal Institute of British Architects.

GENERAL DESCRIPTION OF THE DESIGN FOR MAYO COLLEGE AT AJMERE.

The style of architecture selected for the Design is the "Hindustani" or "Hindu Saracenic," Lord Northbrook having decided that this style will be the most suitable one to adopt for a building of the kind, in a Province abounding in fine examples of similar architecture, and in which the Native Chiefs themselves have unanimously adopted it for their own palaces and other buildings. Pure Hindu architecture, besides being extremely costly from its massive construction and elaborate ornamentation, is scarcely capable of satisfactory adaptation to modern requirements. The fusion of Hindu and Mohammedan architecture which has been developed in Rajputana is, however, admirably suited for such adaptation, meets the exigencies imposed by the climate, and harmonizes with the tradition of the people.

In preparing this Design every precaution has been taken to use only such Mohammedan features and forms as the Hindus of Rajputana have themselves almost universally adopted (such as cusped arches, modified forms of domes, &c.), and in using them to so subordinate them to Hindu feeling and treatment, and to so supplement them by purely Hindu forms and details, that the whole design may be almost literally described as being an adaptation of modern Hindu domestic architecture, and therefore thoroughly suitable, as far as architectural treatment is concerned, for a College in which the sons of (with few exceptions) Rajput chiefs and nobles are to be educated.

The accommodation provided in the building has been arranged in consultation with Major St. John, R.E., and may be described as follows :—

The building consists of a central portion with two almost symmetrical wings, one on each side. In the centre is a large hall for lectures and examinations, &c., 68 feet by 40 feet in extreme dimensions, its east end being nearly a semicircle.

In front of the lecture hall is the main entrance porch (25 ft. 6 in. by 14 ft., with a large open entrance arch) of 16 ft. 6 in. span. In rear is a vestibule with a small entrance porch supported by pillars of Hindu form, with bracket capitals.

The north wing provides one class room 24 ft. by 22 ft., library 40 ft. by 24 ft., small water room, store room, lavatory and room for bearer. The south wing is similar except that the large end room corresponding to the library is divided into two rooms, one for the principal (with attached dressing room and lavatory) and the other for an office. Ample provision of verandah is made both in front and rear, giving convenient and sheltered access to all parts of the building, and the greater part of the rear verandah is enclosed by glazed sashes (being on hinges to open when required), thus affording communication between all parts of the building without admitting hot air in the summer, and without passing through the different rooms. During the cool months the glazed sashes of the passages can be kept open whenever necessary.

Considerable variety of outline, both of plan and skyline, is secured by the projection of the lecture room and large end rooms both to the front and rear, and by the provision of a clock tower 94 feet in height at the S.E. corner of the vestibule; small domed entrance porches are also provided at the ends of the building; cupolas of varied forms crown the different angles, and a small bell turret (in which to hang a bell, the funds for which have been presented by a native resident) is corbelled out from the N.E. angle of the roof of the vestibule. Two octagonal minarets are also introduced at the front angle of the lecture hall (to give emphasis to the central feature of the front), and terminate at the roof-level in cupolas crowned by the well-known Hindu "Sikra" domes. The clock tower will form the most prominent feature in the design, and will, as a feature in the landscape, give additional importance to the college as the central building of the group in the absence of any lofty and massive central feature, for the provision of which the funds available will not suffice. It has been purposely placed at an angle and out of the centre of the building, to obtain a picturesque effect, and because it is not of sufficient mass for a central dominant feature in the design.

The tower has a richly moulded and slightly spreading base, and is taken up as a square to the height of 22 feet from the ground. From this point it is chambered to an octagonal shaft, which, at the height of 58 feet, corbels out again to the square form, ornamental pendants being introduced at the apex of the corbelling at each angle. Above the corbelling bold stone brackets support a narrow projecting balcony, with perforated stone railings, above which rises the square clock chamber (with marble angle-shafts), terminating in a richly corbelled cornice and crowned by an iron gilded dome of ornamental design, the sides of which, being pierced by open arcading, will allow the sound of the gongs of the clock (to be suspended in the dome and worked by wires from the clock machinery below) to be freely heard around.

The clock will have four dials, and a floor is provided on which its machinery will rest. Two open shafts are left in the masonry of the tower, in which the clock weights will work.

A brick circular stair rises in the clock-tower to the level of the balcony, from whence a ladder attached to the newall will give access to the clock machinery above. Windows are inserted in the tower where necessary to light the staircase. A door opens on the roof of the vestibule, and another on the balcony at the level of the lecture room roof, with which it communicates by means of a small bridge, which forms a picturesque connection between the upper partition of the tower and the main building.

In the interior of the building decoration of a simple character in moulded panelling, cusped arching, cornices, &c., suitable to the style of architecture, has been sparingly introduced throughout. In the lecture room, however, the decoration assumes a somewhat rich character, as it is probable that this part of the building may occasionally be used as a Durbar Hall. The front doorways are enriched by attached jamb and mullion shafts and pilasters, and their arch heads are filled with perforated scroll work glazed with stained glass, which will also be used in all the doors of the lecture room. Above, panelled arcading decorates the upper part of the walls ; at each end of the hall and in the sides are glazed windows with jamb shafts. The roof is coved inwards to a projection of 6 ft., the depth of cove being 5 feet. A perforated band 12 in. deep and sloping inwards then occurs, over which the ceiling is flat. The cove and flat ceiling will be plastered, the former being divided into panels by moulded ribs with ornamental pendants at their outer ends, and springing from the corbels in the cornice below, which runs round the hall.

The flat portion of the ceiling is panelled by projecting mouldings into a geometrical pattern, in which two large flat glazed lights are introduced covered by skylights with glazed roofs above, in the sides of which a ventilating space is provided all round.

It is proposed that the whole of the rooms (except the office and small service rooms, which will be white-washed) should be tinted in distemper, and the ceiling of the lecture hall also, as shown in the detail drawings. The glazing of the flat lights in the lecture room ceiling will be of coloured glass, one light to be a conventional representation of the sun, and the other one of the moon, the mystical sources from which the chief Rajpoot Dynasties claim to have sprung.

These lights, besides being decorative features, will assist in lighting the room, the ceiling and cove. The construction of the ceiling and roof, skylights, &c. is shown in sheet No. 9. To complete the decoration of the lecture hall the flooring will be of local marbles (red, green, white and grey), the ground white, with simple geometrical patterns in the other colours. As regards the exterior decoration, the ornament (with the exception of the cupolas accentuating the angles and giving variety to the skyline) follows the construction, and is subordinated to it, carved work is sparingly introduced, and is as simple in character as is consistent with an æsthetically good rendering of the style of architecture. The forms generally are most carefully designed to be thoroughly in keeping with the Hindu feeling with which it is intended that the whole design should be pervaded.

Ample light and ventilation are secured throughout the building by full provision of doors and windows. Clerestory windows are inserted in the class rooms, library, office and principal's room ; skylights are provided in the roofs of store and water rooms. Iron cowl ventilators will be fixed in the roofs of library (6), class rooms (4 each), vestibule (3), office (4), and Principal's room (2). In the roof of the lecture hall thorough ventilation will be kept up between the perforated band above the cove and the skylights ; in addition to which circular windows (with glazed sashes hung on pivots and worked by lines from below) pierce the walls behind the cove all round, and numerous small openings (provided with fine wire gauze to keep out insects) open under the stone eaves. Constant currents of air will thus be kept up between the roof and ceiling, and heated air from within will have free exit.

To further assist ventilation near the floor-level throughout the building, louvred panels are provided under the glazed openings in the outer walls of the passages or enclosed verandahs.

Iron and wood being very costly at Ajmere, their employment in the construction of the building is

reduced to a minimum. The door and window frames will be of stone with wooden blocks inserted, to which the hinges will be attached. In the roofs full advantage is taken of the facility with which long slabs of stone can be procured in the vicinity, and the roof spans are reduced by cross arches to a maximum of 12 ft., except in the roof of the lecture hall and main entrance porch where iron guides are employed.

It is proposed to provide a level gravelled terrace round the building at the level of 48·92 ft., as shown in the plan and sections on sheet No. 8, the existing roads being raised to this level where necessary on a gradient of 1 in 40 ; the slopes of the slight embankment thus necessitated being neatly trimmed and turfed all round. A convenient carriage drive will thus be secured all round the building, and its appearance will be much improved, especially in front, by its being raised on a level and slightly elevated platform, the cost of which will be trifling.

Fire-places are provided in all the Principal's rooms, and their chimneys are made ornamental features.

Cast-iron railings of suitable design are provided for the open verandahs and two glazed cupboards (partially sunk in the wall) for each class room, with shelves for books, &c.

Extract from Specification.

(Signed) J. W. BRASSINGTON, Executive-Engineer.

VI. The ARTISTIC TREATMENT of CONSTRUCTIONAL IRONWORK.

By Hugh Stannus, *Associate.*

[Read on Monday, 23rd January, 1882, Horace Jones, *Vice-President,* in the Chair.]

IT will be admitted that ironwork has not been fairly treated either by its critics or by the great majority of its friends. Its critics refuse to use it (except in a very limited manner) as being an "un-architectural" material, and they complain of its "want of bulk and monumental effect," and that no historic style is suitable for it, and that it has no style of its own. And by its friends it has been "drawn-out" or exhibited like a precocious child, and dressed-up in clothes not its own.

2. In answer to the first objection I would refer to the words used in reference to iron by the late Professor E. M. Barry, R.A., in one of his lectures at the Royal Academy: "The world will not stand still for architects any more than for others; and if we do not avail ourselves of the materials at hand, others will certainly do so, and the great works of the day will develope more and more of an exclusively engineering character." Mr. George Aitchison, A.R.A., in a Paper* read here in 1864, said "If any architect of this day has any new and beautiful conceptions that he wishes to hand down to remote generations, by all means let him employ brick, or brick and stone exclusively; let him vault his floors and roof, if he can get the space required for the abutments, and the cost of the additional height; but to those who are engaged in works of more immediate utility, and whose ideas are not of such transcendent merit, I would recommend the use of iron." When required to floor over large spaces, where height is limited and no intermediate supports are practicable, it appears that a man cannot refuse to use iron, therefore acknowledgment of the fact is forced upon people.

3. The apparently strong charge of "want of bulk and monumental effect" has been stated in one form by Mr. Ruskin, in his "Seven Lamps." "Every idea respecting size, proportion, &c., on which we are at present in the habit of acting or judging, depends on presupposition of such materials (*i.e.* stone, &c.):" and he feels it impossible "to escape the influence of these prejudices:" *ergo,* "True architecture does not admit iron as a constructive material." But to object to the use of a material "till we have become accustomed to it" is not more logical than the Irishman's remark that "he could not get on his new boots until he had worn them for a day or two." It should also be remembered that "bulk" is on the side of the pyramids, and of the columns of Karnak; and that perhaps the Parthenon may have been objected to for its "want of bulk." Also that while the noble monuments of our glorious English thirteenth century were being built, the slender shafts may have struck people as much too thin; yet our eyes are used to them, and in time we shall become accustomed to the further attenuation of proportion in iron architecture.

4. The charge that it has no style of its own, *i.e.* that it has not sprung, Athena-like, fully equipped from the brain of the first user, is an unfair one to make at present. The Greek Doric, to take an illustration, was similarly evolved slowly and tentatively, requiring more than a century for its perfecting; and for the use of a material developed within living memory it is rather too soon as yet to expect a perfect style.

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* See the Transactions, 1863-64, page 103.

5. Iron has received the worst treatment from its friends: honest criticism even if strongly expressed is not so harmful as idle ignorance. Like the baby of a family, iron has hitherto been nearly universally clothed in the garments of her older sisters. These do not fit the precocious youngster; and, like other children, she will grow out of them and have her own clothes eventually. This "clothing of her own," or in other words the *characteristic treatment,* is what I plead for. Too long has she been treated unkindly by her elders, like that other poor little sister of the story—too long have stone and wood architects looked down upon iron as a Cinderella; but the time is coming when this younger one may rise up from her cinders and, under the guidance of the fairy, assume her proper place.

6. Limits of the Subject.—The subject is limited to that which forms an essential part of the construction of a building (excluding such adjuncts as railings, grills, &c.), and to such as is *visible;* we have to treat it, not to hide it. I shall then consider whether, without increasing the cost in any great degree, we can so modify the forms, and, without lessening the strength, so redispose the material, that to what is mere construction we may add those qualities which raise a design into the domain of architecture.

7. In laying-down general principles it is often necessary to clear the ground of erroneous ideas. An eminent Divine has remarked, that in all early ethical systems the laws will be generally negative; prohibitory legislation necessarily appears during the infancy of the moral sense, and it is only when a nation or an individual has made advance that the command is changed from "Thou shalt not" to "Go and do likewise." So in the artistic treatment of ironwork, the rôle of any writer must at present be primarily that of the prohibitive legislator. Owing to the false ideas and bad habits which are too common, it is necessary to *unlearn,* so to speak, much of what is practised, before making suggestions for future development. That this is so will be evident to everyone walking along our streets; and even in this room a gentleman has spoken of "fixing leaves (cast in separate pieces) to the bell of a Corinthian capital." But why fix leaves? Why a Corinthian capital in cast-iron at all? The fact is that the Corinthian capital is a stone, *i.e.* a *carved* form, and therefore not suitable for casting. This and other remarks show the un-thought-out ideas which are afloat among even professional men on this subject. I propose then:—

(I) To state the Negative Laws.
(II) To realise the Data of the Problem; and
(III) To suggest the Path along which the Solution will probably be found.

I.—Negative Laws.

8. The broad negative laws may be briefly stated. That constructional ironwork shall be so designed as:—

(i) Not to imitate the characteristic forms of dissimilar materials.
(ii) Not to carry-on the mouldings and other forms of the wall against which it may be placed.
(iii) Not to abut abruptly against the supporting features in other materials, but to have a flange which is visible.
(iv) Not to hide the joints and strengthening parts; and
(v) Not to imitate natural forms.

TRANSACTIONS OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS, 1881-82.

THE ARTISTIC TREATMENT OF CONSTRUCTIONAL IRONWORK, (Nº 7.)

See para. 10 page 115

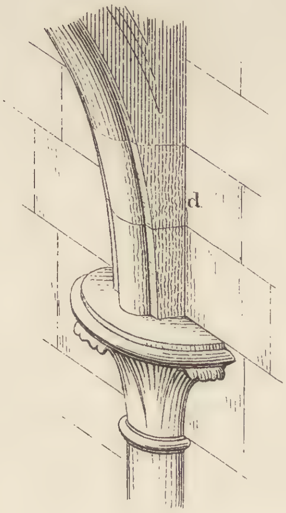


Fig. 1.

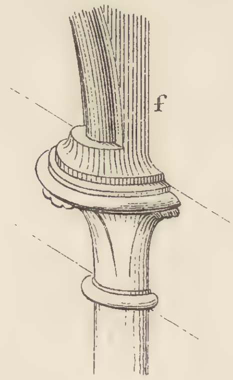


Fig. 2.

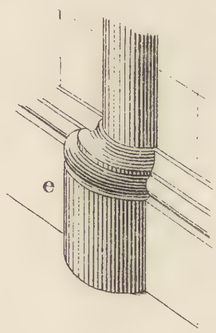


Fig. 3.

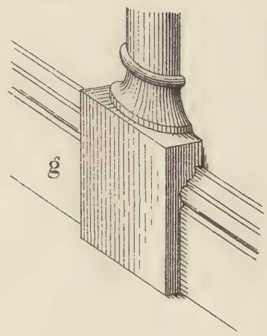


Fig. 4.

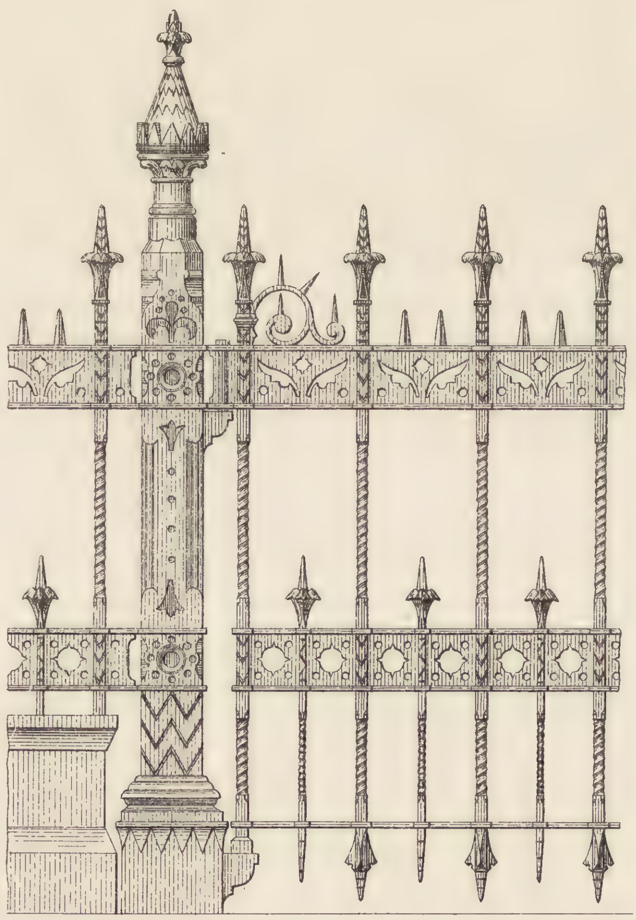


Fig. 5.

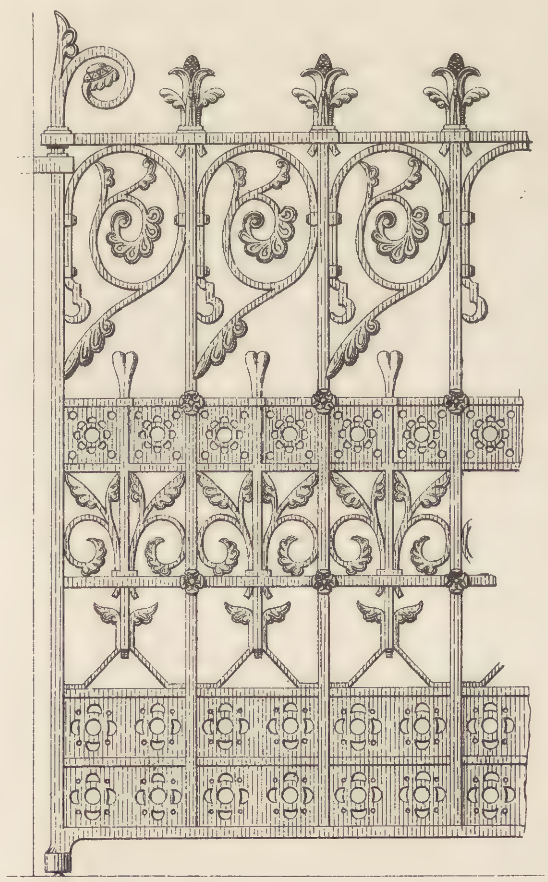


Fig. 6.

Faulty treatments in Cast-iron.

See para. 15, page 115.

C.F. Kell, Lith. 8, Castle Sᵗ Holborn, E.C.

9. (i) It should not imitate forms produced by *undercut carving*, like the Corinthian capital before spoken-of, and the Early-English capitals, as I have seen attempted. Iron cannot possibly compete with the exquisite beauty of these latter, and any attempt can only end in miserable failure. Cast-iron should also not imitate wood treatments, and forms which *vary in sectional area* for manufacturing reasons, which will be alluded-to further on.

10. (ii) This is really a case of the first law: when an iron rib butts upon a springing-course of stone as at *d*, fig. 1 (see Illustration No. 7) or when a base-mould in iron mitres-in with the same mouldings on the wall as at *e*, fig. 3. These should rather be treated as at *f* and *g*, figs. 2 and 4. The bad practice, however, has antiquity on its side, and is all the more likely to lead imperceptibly to deception: it is therefore the more to be condemned.

11. (iii) This is a necessary concession to the æsthetics of the eye; that the flange, or abutting member, shall be *visibly* as well as potentially present; that it may act as a "modulating chord" between the two materials.

12. (iv) It might be supposed that the third "law" should not be necessary, considering how important a part the joints play in all iron structures; but shields, masks, tablets and the like, offer so tempting an inducement to escape the trouble of thinking that they are too often applied (like so much "compo" ornament) for the purpose of covering what the designer thus confesses to be beyond his power. The engineer *does* let his joints be seen; the architect *ought to* acknowledge them, and by proper treatment make them an important feature of his design, the fact being that wrought-iron work is really a design of joints.

13. Also (v), in the selection of motifs, cast-iron must not be ornamented with natural foliage. This is a case of the general law which states that in all mechanical repetition the forms should be conventionalized. In a series of naturalesque carving, in which each feature has been separately studied and individualized, we admire the loving care shown in the perpetuation of so many images of beauty; but from a succession of the same flower or group of flowers repeated in cast-iron, without either the infinite variety or the delightful crispness of nature, we turn away in disgust.

14. In giving a few instances of breaches of these laws, it should be stated that they are not by any means the worst that could have been chosen, but merely those which lay more conveniently to hand. The sketch I hold shows a portion of an iron structure in one of our southern suburbs. Here the stancheon has a capital suggesting courses of stone; the curved bracket, which is only 2½ inches wide, rests on a console with double volutes 6 inches wide, the said console shows no *visible* fixing to the wall; and the whole, though making use of architectural forms, is very far from being architectural. Some engravings of iron architecture in America are also well-known, in which the coursing and jointing of stonework is imitated, arched forms are introduced, and thickly spaced consoles are used in the entablature.

15. The figs. 5 and 6, in Illustration No. 7, show some faulty treatments, inasmuch as the treatment appropriate to wrought-iron has been imitated in cast-iron. Thus we see that cast-iron is the chief offender: not only has it been made to imitate stone forms, but also those of wrought-iron; and it is this *imitation*, this apparent *aping* of something better than itself (whether it result from a desire to deceive, or it be ignorance and consequent unthinking borrowing of detail), which is to be reprobated by all architects. We have it in our power to show the material we are using by the treatment we adopt, so that a thoughtful spectator

could say, "That is cast-iron, this is wrought-iron, and the other is gun-metal or bronze"; and this should be our aim as artists. Truthful, unaffected work is almost sure to command respect. I suppose we nearly all agree that the Crystal Palace at Sydenham is fairly right. There we see no attempt to borrow details from other materials, or to hide the construction, but the designer has considered the practical capabilities and necessities of his material; and I venture to suggest to those who wish to develope the proper treatment, that, since they have somewhat "lost the scent," they should "hark back" to that or similar treatments, and strive to unlearn much that has been done since.

II.—The Data of the Problem.

16. Leaving the first division of the subject—an invidious and unpleasant one—I will now strive to set down in order the advantages and difficulties of cast and wrought iron as compared with stone or brick, and the consequent capabilities and necessities in construction; to the end that we may develope the ornamentation from the construction, and, becoming possessed with the spirit of the material, we may accentuate its characteristic qualities. The advantages of cast-iron are:—

(i) Modelled surface, giving richness and hiding inequality,
(ii) Cheapness of production when there is a repetition of the same factors,
(iii) Largeness of pieces,
(iv) Easy renewal of parts, and
(v) Beauty of perforation when seen against the sky or light.

The disadvantages of cast-iron are:—

(vi) Rust and deterioration, and hence the necessity of easy access to every part for frequent inspection and painting,
(vii) The "strip" necessary for moulding in sand prevents squareness, and
(viii) The difficulty of making the joints and bolts "artistic."

The advantages of wrought-iron are:—

(i) Tensile value,
(ii) Lightness as compared with strength,
(iii) Largeness,
(iv) Easy renewal, and
(v) Beauty of perforation.

The disadvantages of wrought-iron are:—

(vi) Rust, &c., as before,
(vii) Difficulty with joints, bolts, stiffeners, &c.

17. To design ironwork, whether cast or wrought, so as to overcome these difficulties, and produce works which may stand comparison with those in stone, &c., which have the advantage of prescription, is a hard task at present; but just as the difficulties in the world bring out the nobler qualities in man,—and it is not in avoiding, but in overcoming, that he developes his differentiating faculties,—so it is not by slurring-over or hiding the special difficulties in ironwork, but by acknowledging and emphasizing them and by developing the artistic treatment out of these very difficulties, that we shall show the material by the character of the design. The curved form of the arch, and that most perfect evolution from it—

rib-vaulting—were both resultant from a disadvantage: that the workmen had only small stones and limited funds, instead of those megalithic quarries and rich treasuries which had rendered trabeate construction possible. So in iron architecture: if the forms be deduced logically from the difficulties of the material, there is a great future before it, and also, I believe, before anyone who will take the trouble to master its capabilities.

18. Cast Iron.—In designing for cast-iron, it is important to arrange the material so as to have a uniform thickness if a relief or panel, and a uniform bulk if a perforated design; as during the process of casting, the parts of greater bulk will remain hot after the thinner parts have cooled and become rigid, and when they contract they will snap away. When the whole of the parts of the casting are of nearly equal bulk or sectional area, they all cool and contract simultaneously. Where the parts are "lumpy" and cannot be cored to get rid of the superfluous bulk, then the design is at fault. When the work is to be seen from both sides—*e.g.* in spandrail panels—then, if the surface be modelled, the back and front faces may be different. This for two reasons:—

(i) To save metal and prevent snapping while cooling.

(ii) To be more interesting and more like nature.

19. When there is foliated ornament in sunk panels, or the ornament is perforated, it ought to touch the line of the style-moulding all round the shape of the panel. This is well, both as being easier to mould and as showing growth and vigour. The surfaces of unperforated panels, when not ornamented with foliage, should be granulated, vermiculated or diapered, in order to hide the inequality which often results from the processes of manufacture.

20. In cast-iron the multiplication of parts from one mould is inexpensive; hence all cast-iron structures may be designed with repeats of certain factors. If the most commonly repeating factors in any structure be varied in design, and the moulds for these be made so as to be interchangeable, great variety of effect can be produced with little expenditure of means; and it only requires a little more thought to arrange this. Thus, in the Royal Horticultural Society's buildings, at South Kensington, the shafts of the terra-cotta columns are built-up in three lengths of about 2 feet each, with about eight varieties of drums; and these drums are changed about in their disposition, giving more intricacy and interest to the design. This making of the terra-cotta in drums or short lengths was a necessity of the material which does not exist in cast-iron. The same variety can be obtained by making several sets of interchangeable models, which may be joined together in different combinations for moulding the different columns. The number of combinations which may be made of eight factors, taking them three at a time, is 336, which is certainly more than would be required. Thus the number would be—

Upon seven	210
Upon six	120
Upon five	60
Upon four	24

Thus the architect may suit the number of combinations to the purse of the patron. The above general suggestion has been made with reference to columns; but friezes and bandings may also be varied, within a certain limit; and panels to any extent. Where columns or piers are large, another source of variety exists, which may be seen in the treatment of the

large terra-cotta columns in the front of the theatre block at South Kensington Museum, and also in that of the Science Schools, connected with the same Institution, in Exhibition Road. These columns are each built-up of six drums, three alternate ones of which bear figures in low relief, representing the occupations of the three ages of life. These drums are turned round upon their axis, and disposed so that any one of the three drums of any of the columns presents a different portion of its circumference, towards the spectator, from the corresponding drum in the other columns; and this *turning-round* of the same factor in large columns may be copied with equal advantage to the "ringing the changes" in small ones.

21. WROUGHT-IRON.—In large masses of wrought-iron work the artistic treatment can be shown, generally, in the following ways:—in the *proportions* which the distances, of the various parts and joints, bear to each other; in the treatment of the *joints* themselves; and, inasmuch as construction when reduced to its lowest term is merely the art of bridging over a space, and the greatest number of large wrought-iron structures will be bridges and roofs, and therefore will be generally seen against the sky, the *shapes of the perforations* must be taken into consideration.

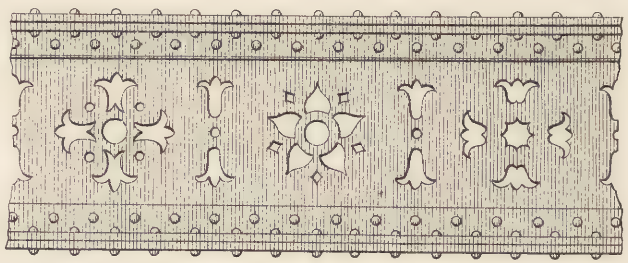
22. It will be seen from a consideration of the processes of manufacture that rolled-iron is a straight unlovely thing and that there is nothing æsthetic about a length of angle-iron, and no human emotion is kindled by the difference between a ⊥ and an ⌶ girder; but when an *assemblage* is composed of these, we see that, in addition to scope for the qualities already touched-upon, there is a field for the treatment of the joints. The proportion and articulation are, in fact, in many cases, almost the only points in which refined treatment can be shown; and in such cases the design becomes a design of joints arranged relatively to the points of support, the load to be borne, and the nature of the material used. If we do this, banishing all preconceived notions gathered from our dealings with other materials and merely working-out the mathematics of each problem, we shall find the result come out as beautiful in its simple unaffectedness as our old English domestic work, and subtle in its curvature as is the Parthenon.

23. In dealing with the shapes of perforations, it is well to contrast the method of producing ornament in the two materials: each has a treatment peculiar to itself; and we should emphasize this in design. In wrought-iron plate work, panels and bandings, the ornamentation should be made by the shapes of the *perforation;* because the plate is an *existing thing* before the ornamentation is applied to it, just as in "plate tracery" the masses of stone are *existing things* before the perforations in the window tracery are cut through. In cast-iron the case is different: it does not exist till the pattern has been pressed into the sand of the mould, and the metal has been run into the cavity. Hence the *metal itself*, and not the figure of the perforations, should give the effect to the eye. The metal itself is the part to be treated ornamentally; and any attempt to treat it as flat, and perforate it in ornamental shapes, would be wrong, as not showing the capabilities of the material.

The perforations in the wrought-iron would probably be produced by punching. It is easy to arrange diapers, meanders, or panel-ornaments, in which six or eight, or fewer, punching tools for leaves, &c. would produce an inexpensive and satisfactory result; it must be, however, borne in mind that punching strains the iron for a short distance round each hole, so they must be kept well apart, and in all cases leave sufficient metal along the lines of strain,

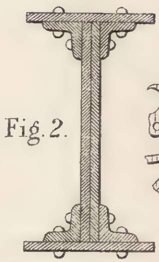
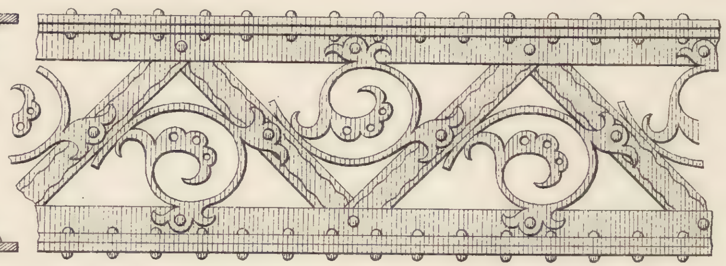
THE ARTISTIC TREATMENT OF CONSTRUCTIONAL IRONWORK, (Nº 8.)

Fig. 1.

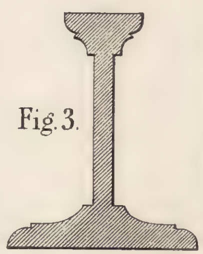
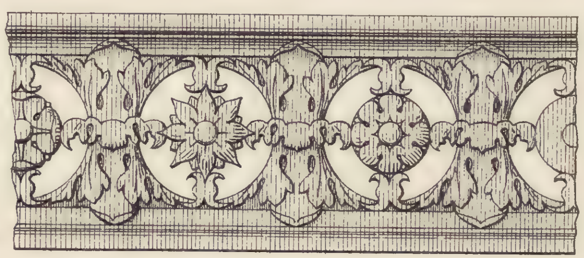
Wrought-iron: perforated plate

Fig. 2.

Wrought-iron: fashioned

Fig. 3.

Cast-iron: small girders.

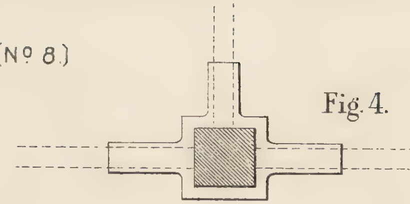


Fig. 4.

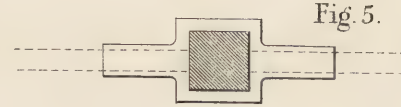


Fig. 5.

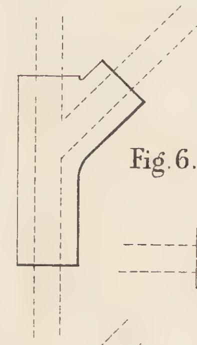


Fig. 6.

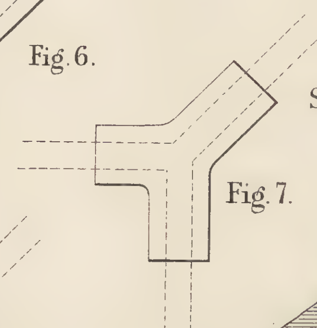


Fig. 7.

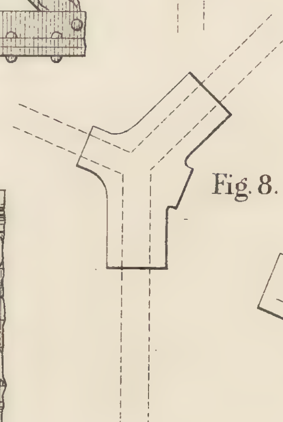


Fig. 8.

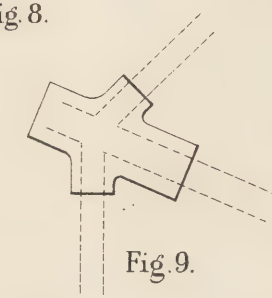
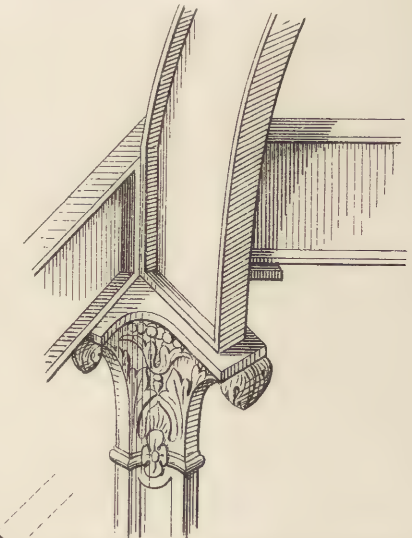
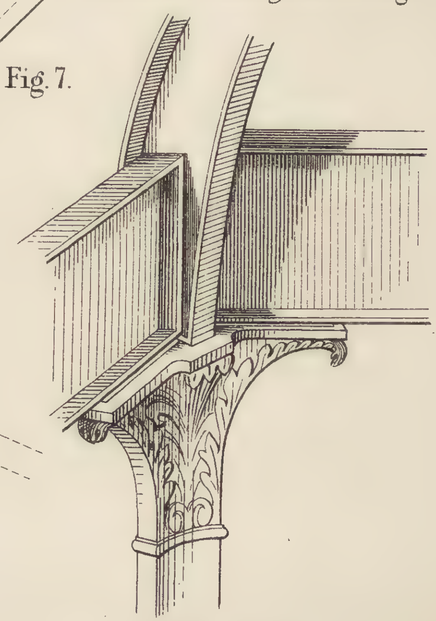


Fig. 9.



Sketch of arrangement in Fig. 9



Sketch of arrangement in Fig. 8.

C.F. Kell, Lith. 8, Castle St. Holborn, E.C.

so as not to weaken the plate or assemblage. In addition to the tools for leaves, &c. circular holes may be drilled of different diameters, and help to vary and enrich the ornamentation.

The operation of perforating wrought-iron will necessarily leave the edges of the holes square with the plate and showing its full thickness; whereas in cast-iron the necessity of making a thin edge, to "part the sand" at the junction of the two flasks, makes conical holes, and reduces the apparent thickness of the metal round them.

Again, in scroll-work: the hammering of wrought-iron, in the operation of forging, produces squareness of face and even hollowness at the side, a character which it is extremely difficult to produce in cast-iron; whereas in cast-iron scroll-work the section most suitable for "drawing" away from the sand is a lozenge form, which would be expensive in hammered scroll-work. Thus the best treatment (or the most technical treatment, *i. e.* the one most suitable to each material) is the cheapest.

24. For examples carrying-out the above contrasted treatments of the ornamentation I would refer to figs. 1, 2 and 3 in Illustration No. 8, and to figs. 6, 7, 8 and 9 in Illustration No. 10. The ironwork of an arch in South Kensington Museum shows a cast-iron arch, which is flat and perforated in a design suitable to a rolled plate, and is therefore to that extent a breach of the above laws.

III.—The Suggested Path.

25. Servile copying of the features of stone for the details of iron architecture has been strongly deprecated: it is not necessary therefore to cut ourselves off from the accumulated wealth of beautiful forms bequeathed to us from the past; but in using them we should exercise thought and judgment in our selection of motifs. Many old buildings have details which are extremely suggestive, by reason of their having been produced by means of similar processes, and I plead for eclecticism until the development is advanced.

26. When the engineer of one of our London railway termini, having settled the strictly utilitarian part of his station-roof, left it for artistic treatment to his architectural collaborateur, the latter adopted the Moresque plaster details for his ornament, they being formed in a similar way to cast-iron, *i. e. by casting.*

27. The terra-cotta style, which flourished in the valley of the Po during the fifteenth and sixteenth centuries, has some features which might serve as motifs. The quantity of surface panelling renders it easy to join the plates together; the ornament, being in low relief, is easy to cast and not liable to harbour dust or rain, and, being well distributed over the ground, affords a good opportunity for gilding or picking-in.

28. Some of the Indian buildings, which have been so finely illustrated by Mr. Fergusson, present also great wealth of suggestive detail for surface ornamentation.

29. But I venture to suggest that the style for iron must be different from any other architectural style which has appeared in the past. It cannot be wedded to the stone-forms of any style of the past; but availing ourselves of the accumulated experience, and carefully studying the various solutions which have been given by these older builders to the problem presented to each in turn, it may gather-up good features and obtain sympathetic treatment from each. Thus it might garner:—

(i) Purity of line, and mathematical proportion of the Greek,

(ii) Distribution of surface decoration of the Mohammedan,

(iii) Richness of modelling of the Roman,

(iv) Simplicity of parts of the Romanesque, and

(v) Economy of material and constructive truth of the Gothic.

Take what is good from each, and assimilate all to make a homogeneous and progressive style.

30. In submitting some sketches for the purpose of showing the application of the principles enunciated, three factors of construction have been selected, viz.:—

(i) Stancheons—for compression,

(ii) Cantelevers and Brackets—for mixed strain, and

(iii) Straps and Ties—for tension.

31. STANCHEONS.—I use this word in preference to "columns," as there is danger when borrowing the nomenclature that we may be tempted to adopt the treatment also. I therefore suggest that we speak of "hollow stancheons" instead of "columns," and of their "upper and lower flanges" instead of "caps and bases."

32. We should bear in mind that, though all structures are built *upwards* (except those projected at Laputa), they are designed *downwards, i.e.*, the roof determines the supports*; and hence the articulation of the superimposed girders should determine the plan of the abacus or, as I prefer to call it, the "top-flange." On no account should it be circular unless turning in a lathe is a necessity, but it should rather follow the general lines of the construction, as shown in Illustration No. 8, figs. 4 to 9.

33. THE SHAFTS need not necessarily be made cylindrical. That section is associated with stone forms produced in a lathe; hence, where money will allow, it is desirable to adopt octagonal or cruciform shapes, unless some other section be demanded by the circumstances of the case (see Illustration No. 9, figs. 3, 4 and 5). In addition to being a marked variation from the usual stone-forms, and allowing greater interest to be given to the work, such sections, by forming narrow faces, which would be of the same width as the soffit of girder over them, give more unity to the *assemblage.* The arch-moulds in Gothic architecture may serve as a model for the treatment of columns in cast-iron. Where a number of ribs ramify from the same column, the shape of the latter will be something like the two sketches of piers in Illustration No. 9. These, however, are essentially stone treatments, and are well calculated for jointing the stones, so as to make bond. In cast-iron, on the other hand, the section should be such as does not suggest the possibility of bonding.

34. Another point, upon which stress ought to be laid, is the necessity of destroying or interrupting the horizontal lines. Whenever a stancheon is treated with interchangeable drums, and also whenever a series of decorative mouldings are taken horizontally across any casting, there should be some ornamental feature to interrupt them. It must be borne in mind that horizontal mouldings suggest courses (of stone), and by interrupting and destroying them we show that the parts above and below them are in the same piece, and not put together in courses. Various methods of doing this, *e.g.*, a rosette, a volute, &c., may be suggested.

* See *The Architecture of China*, by William Simpson, F.R.G.S., *Hon. Associate* (TRANSACTIONS, 1873-74, page 33), in the opening lines of which it is stated that, in China, the "framework of the roof is first made on the ground on the exact spot where the house is to be. It is then raised up, and the pillars are placed below to support it; and the walls are afterwards formed."

THE ARTISTIC TREATMENT OF CONSTRUCTIONAL IRONWORK, (No 9.)

Fig. 1. (See para. 35.)

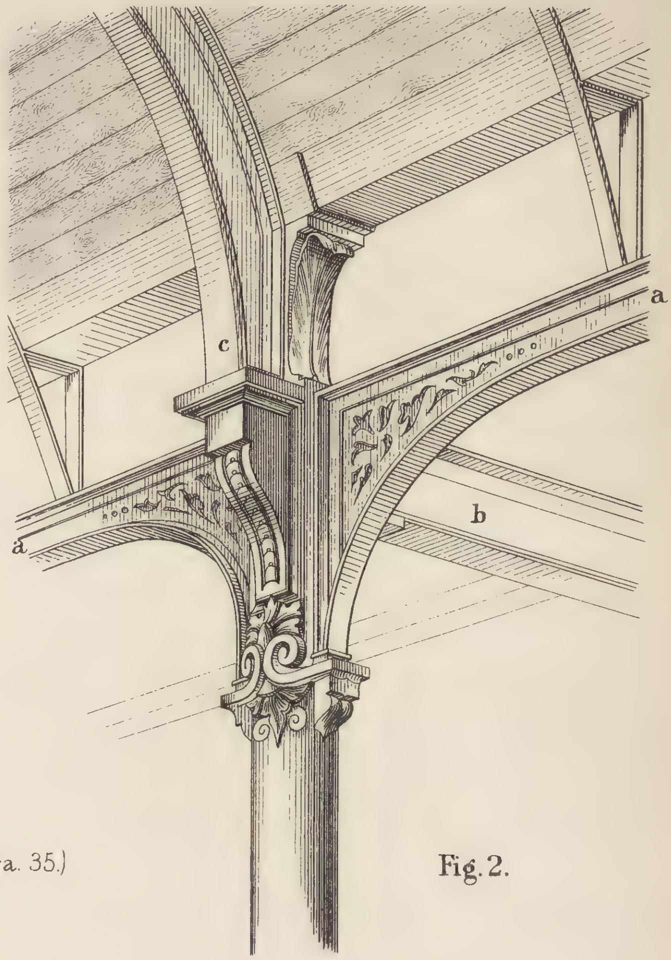


Fig. 2.

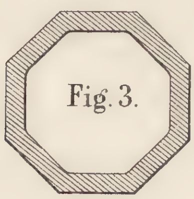


Fig. 3.

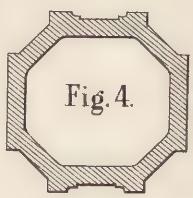
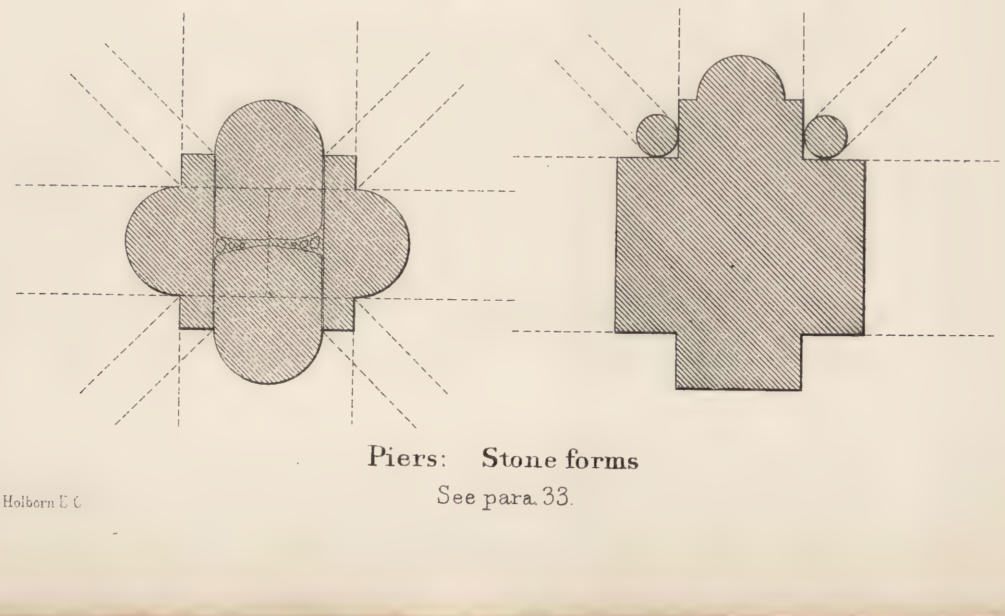


Fig. 4.

Fig. 5.



Piers: Stone forms

See para. 33.

C F Kell, Lith 8 Castle St Holborn E C

THE ARTISTIC TREATMENT OF CONSTRUCTIONAL IRONWORK. (No. 10.)

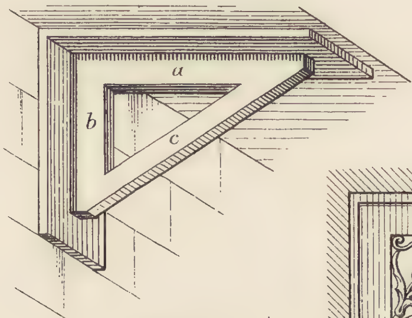


Fig. 1.
See para. 36.

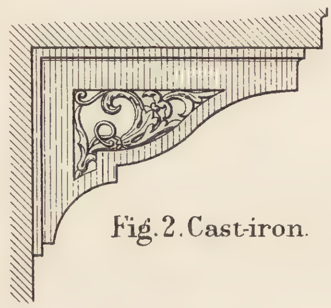


Fig. 2. Cast-iron.

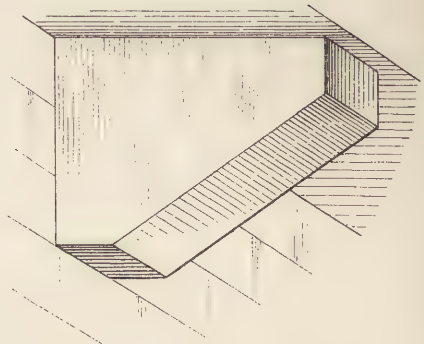


Fig. 4. Stone.

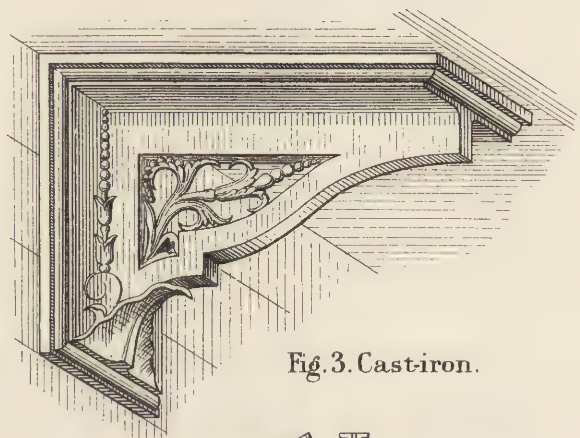


Fig. 3. Cast-iron.

Fig. 5. Stone.

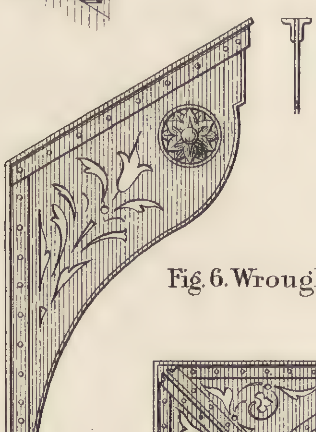


Fig. 6. Wrought-iron.

Fig. 7. Cast iron.

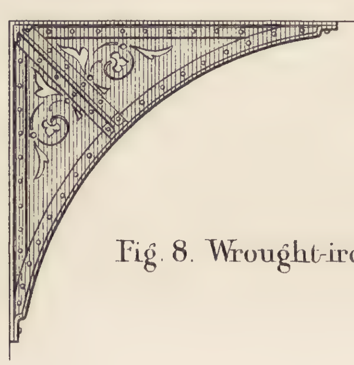


Fig. 8. Wrought-iron.

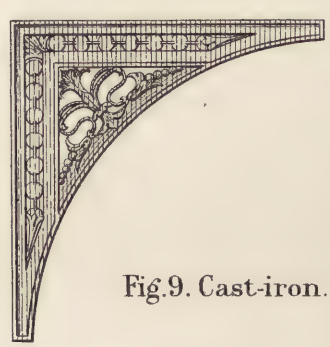


Fig. 9. Cast-iron.

Cantelevers and Brackets.

C. F. Kell, Lith. 8, Castle St. Holborn, E.C.

35. There is a Concert-room at one of our sea-side towns which contains, in my opinion, an error in iron construction, and it will afford me an instance of a wrong combination of parts. In this room the arched ribs supporting a boarded ceiling are about 3 inches wide; the square parts above the stancheons are about 16 inches wide; so that, seen from the centre part, it gives somewhat the effect shown in Illustration No. 9, fig. 1. The "build-up" looks preposterously large for the little rib. Now, I think, if we examine this stancheon, we shall see it has three duties to perform:—

(i) To support the arched rib *c*,

(ii) To support the longitudinal girders *a a*, and

(iii) To support the transverse girder *b*.

These three duties ought to be acknowledged in the plan of upper flange, if not in the section of the shaft. Then the effect would be as shown in fig. 2, in Illustration No. 9, where it will be seen the design is deduced from the necessities of the case; and each part appears to perform its own proper part of the work.

36. Cantelevers consist of three parts (see Illustration No. 10, fig. 1):—

(i) The tie *a*, in tension,

(ii) The plate and web *b*, in mixed strain (either of which predominates as the cantelever is high when it is most in tension, and low when it is most in compression), and

(iii) The strut *c*, in compression.

Then, as theoretically the compressive strength of cast-iron is six times greater than its tensile strength, the strut *c* need only be one-sixth of the sectional area of the other parts. In wrought-iron the opposite would be the case, the back and top should be slight and the front thickened. The design for a cast-iron cantelever should show the proportions laid down above (fig. 1); and it may be ornamentally developed, as shown in figs. 2 and 3 (see Illustration No. 10). The stone cantelever (fig. 4) may be carved as in fig. 5; but to treat a cast-iron cantelever thus, as is too often done, is wrong. It will be seen that every part of my cast-iron cantelever (fig. 3) can be painted; but in a "box" cantelever, such as those which support (?) our balconies, this is not possible. It should further be taken into consideration how far the flanges are required, and if the whole of the back flange be in compression; also whether tie-rods be used to hold the cantelevers back to the wall.

37. Brackets form an important part of the constructive uses of iron. They are often bolted to the upper parts of columns for roofs, &c. It will be observed, in my sketches, that I have strengthened the backs and tops of the brackets to show their cast-iron character. When very large brackets are desired, they may be cast in several pieces and the design arranged so as to allow of this by subdivision into panelling, &c. The figs. 6, 7, 8 and 9, in Illustration No. 10, show the wrought-iron and cast-iron treatments of these brackets contrasted.

38. Generally, it is well in iron construction to emphasize bracket forms and spandrail-panels, and to combine cast and wrought iron in such a manner as to take advantage of the peculiar qualities of each. In some of the sketches cast pateras and other ornaments are shown which are useful in stiffening the thin wrought web. Cast panels are also very useful in the spandrail spaces of roof principals, and some charming instances of this treatment may be seen at the South Kensington Museum, executed from the designs of General Scott.

39. Straps are always of wrought-iron. They may be simply ornamented with marginal

lines running in the direction of their length to express the *tensile* duty of the strap. If other ornament is wanted, they may be punched in patterns symbolic or suggestive of rope, chain or any binding element, or with leaves growing along the main line. The various methods of applying a strap will be evolved out of the necessities of each case as it arises.

40. Tie-Rods are difficult to treat. Perhaps it would be sufficient to make them of a rectangular section and twist them at certain parts of their length. The twisting does not take from their strength, and would tend to give variety.

In conclusion, this subject is impossible to handle without plagiarism conscious or unconscious, and without appearing elementary. Much of what has been said is crude and ill-digested by the side of M. Viollet-le-Duc's careful and elaborate treatment;* but the absence of any essay on the subject for two successive sessions, when the honour of the Institute Medal was offered some years ago, led me to put these thoughts together. No style is made by any one man or any knot of men, but by a succession of minds patiently working at the same problem, each standing on the experience gained by his predecessor, and content to be a part of the whole, to remain unknown, it may be, like the nameless master-workmen of so many of the grand mediæval remains, rather than seek to advertise himself by something *outré* which might catch a passing fashion. The above collection of thoughts is offered towards the solution of a problem which will press more and more upon us; and I venture to think that by working along the lines laid down, by developing the good in all work, and availing ourselves of the wealth of inspiration to be gained by the study of nature and of man's works in the past, and, above all, by deducing every step logically, we shall, *insensibly* (it may be) and *slowly* (it should be), but not the less *surely*, evolve an iron style.

* See the second volume of Viollet-le-Duc's *Entretiens sur l'Architecture*, particularly the 12th and 13th lectures. In the former he treats of questions relating to mixed iron and masonry construction; in the latter he gives suggestions for constructional ironwork applied to a modern Hôtel-de-Ville, the drawings of which are also given, and he concludes with a scheme for iron vaulting. The following extracts show the line of argument taken upon this subject by the great archæologist:—"We can understand how persons who are ignorent of the art of construction should maintain that certain materials—iron for instance—cannot be used for great public monumental buildings; for iron has not hitherto been used in our public edifices in ways accordant with its properties. It may be pleaded that what has never been discovered is undiscoverable; but it is somewhat difficult to understand how professional men should be willing to admit this view; or how, if they do accept it, they should apply forms to iron which the arts of bygone ages gave to other materials, such as marble or stone. The more reasonable view would seem to be that, if iron is incapable of being adapted to architectural forms, it should not be used in our public buildings; while on the other hand, if it is thought necessary to employ it, such forms should be given to it as harmonize with its qualities and indicate its use. This is not merely a question of art, but of economy. To use cast-iron for supports on account of its rigidity, and then to cover it with brick and stucco, or marble, is to pay for two supports instead of one, which would have been sufficient. To disguise iron vaulting by burying it in masonry is to belie the construction, and to employ double the quantity of materials required. Would it not be more natural to endeavour to give these materials the forms suitable to them, and to arrange the architectural features accordingly? This has not yet been accomplished I admit, but is its attainment an impossibility? and should we not endeavour to accomplish it? Forms proper to the nature of the materials employed may not have been discovered in a single day, or by a single artist, even though a man of genius; but it is desirable to begin. For in architecture a true and rational form reveals itself only after a series of efforts and trials methodically conducted. It was only after some years of endeavour that the Greeks, ingenious though they were, invented the Doric Order; but while advancing it to perfection they did not amuse themselves on the road; they did not seek hither and thither for a variety of æsthetic expressions. Having

JOSEPH JENNINGS, *Fellow.*—I had no thought or intention of rising to speak on the present subject, but as there are several things on the question of iron construction which have not been referred-to, which I think it desirable should be referred-to, I will make a few observations on the Paper. In the first place, the lecturer has taken no notice of the question of the protection of iron from rust except by paint. Now if we are to expect, as I hope we may, the oxidization of iron will succeed eventually in such a way as to prevent its decay by rust, that itself will very much alter the position in which we shall be in connection with the use of iron. You have probably most of you seen it—as it has been carried-out to a small extent —and I believe there is a probability that it may be used in much larger quantities. As regards the use of iron for construction, I quite agree and go much further than he does in saying, columns are not right for the construction of iron at all. I think hollow columns of iron are altogether an unsound use of the material. As he says, you cannot get to the interior, and it must decay in the interior, and I think that sections of iron posts or supports should always in preference be a cross, in which all the thickness of the iron is equal, and in which you see the whole of it, and can make use of any invention to preserve it. I think what he has observed on the subject of piercing iron is guarded against in the present day. There would be no weakening as far as the action is concerned of punching, because at the present time the punching would be so accomplished by pressure as in no way to injure the iron. Of course, by making openings through the iron, you decrease the weight, which is one important object you have in view, as it may be done without decreasing the strength. Then on the subject of

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adopted a principle they never lost sight of it for a moment; never separating the true from the expedient, and never imagining that the beautiful can manifest itself apart from sound reason, sincerity and utility. Is it not an extraordinary assumption that the architect is limited to the employment of certain materials, if he would obtain beautiful form? Beauty, in our opinion, lays claim to a wider empire; it is the true and fitly chosen expression in the particular material at our command, of the physical or moral requirements we have to satisfy." See *Lectures on Architecture* (Vol. II., page 115) *translated from the French of E. Viollet-le-Duc, by B. Bucknall, architect, Lond.* 1881.

"When the public first remark the appearance of iron employed as the principle means of construction in a public building, they are inclined to associate it with structures of the same material employed in a railway terminus, a market or a factory. But is it by masking this material, as many of us have endeavoured to do, that the criticism thus arising can be obviated? I think not; rather, on the contrary, by rendering thoroughly apparent the veritable function of this material. It is evident that the attempts hitherto made in this direction are timid, showing a lack of courage to depart from certain time-honoured architectural forms which are not appropriate to the new appliances at our command. Iron possesses very useful properties, and we should make it our object to utilize and manifest these properties, not to disguise them. A practical architect might not unnaturally conceive the idea of erecting a vast edifice whose frame should be entirely of iron, and clothing that frame—preserving it—by means of a casing of stone. [This idea is certainly dominant in the construction of the new Church of St. Augustin in Paris. It only wanted working out to be frankly accepted with all its consequences. If the architect of that edifice had taken advantage of the methods presented by some of the mediæval buildings which exemplify an analogous principle of structure, he would have realized effects far more satisfactory, because they would have been more in accordance with the means adopted. He would also have somewhat lessened the cost of the building,—a consideration never to be despised. In any case, however, it exhibits a step in advance—a hesitating step, it is true, but one which, in the present condition of our art, deserves to be noted as a symptom of returning independence.] By means of iron the thrusts of vaulting can be almost entirely counteracted, and considerable strength can be given to slight supports. But it cannot too often be repeated: iron should be left independent; it cannot be allied with masonry in large buildings. It possesses properties special to itself in point of resistance, elasticity and expansion, and which are contrary to the very nature of masonry. Employed as a support, cast-iron is rigid and incompressible, while masonry, consisting of layers, always sinks a little through the drying of the mortar which fills in the joints. Hence a

castings there is at present a great objection to unequal thickness in casting, but that is only an objection, as the cooling is at present carried-out. If it were worth while there would be no difficulty in cooling iron as you anneal glass by proper ovens, and it could be cooled equally, notwithstanding any thickness in any one part of it. We also know by the beautiful ornaments cast in Berlin, for ladies' ornaments, that you may have the most beautiful and perfect casting of the finest possible articles. We—I should rather say you, for although I have had a good deal to do with iron construction, I have nothing now—have to deal with the subject so very much more from the £ *s.* *d.* point of view (you have always so very much to consider the question of expense) that the very best construction is seldom attempted. I trust that, in the course of the next twenty years, there will be further great alterations in the whole manufacture and preservation of iron. We know now that the riveting which used to be done by hammering is entirely done by pressure, and it is said to be stronger and more effective than hammering. I do not pretend to give an actual opinion on that, but when we see such alterations as that taking place we may expect in other parts of iron manufacture that there will be considerable alterations also.

ARTHUR W. BLOMFIELD, M.A., *Member of Council.*—The rule laid down by Mr. Stannus in the Paper to which we have just listened—that we should not revert to forms used in stone construction for ideas as to what would be proper in ironwork—reminded me of a remarkable Paper, read before the Architectural Association by Mr. Skidmore a good many years ago, in which he attempted to show that architectural forms were in a great measure

wall built behind a cast-iron column will sink somewhat, while the column will not yield. What is supported by the column, therefore, must not at the same time rest on the wall, for there will result a difference of level between the two supports, and consequently a disturbance of whatever is supported. Hence we conclude that the rigid support ought to be placed on the outside, and the masonry inside ; for then the sinking of this latter would only result in directing the pressure towards the centre of the building. But if we put cast-iron columns against the wall of a building inside, and rest iron trusses, *e.g.* on the columns and wall, we run great risk of causing partial and general dislocations in the building. If, therefore, we undertake to encase an iron structure with a shell of masonry, that shell must be regarded only as an envelope, having no function other than supporting itself, without lending any support to the iron, or receiving any from it. Whenever an attempt has been made to mingle the two systems, mischief has resulted in the shape of dislocations and unequal settlements. In this particular, a close examination of our great mediæval French buildings will supply us with a useful precedent, for in these edifices the frame (that is, the piers, arches, vaulting, buttresses, and flying-buttresses) is independent of the enclosure. But, through the blindest of prejudices, we prefer committing blunders to making use of well-tested principles : and in order not to *retrograde*, as our architects say, they deprive themselves of the knowledge gained by a whole series of experimental investigations—knowledge which would naturally lead them to give iron structure its veritable function. The determination not to benefit by these precedents, which are so favourable to the development of iron construction, is so very evident, that it would be amusing if anything less serious or costly than architecture were in question. There is one of the systems of what is called Gothic vaulting, which seems to have been designed in anticipation of structure in iron, viz., that which was adopted in England towards the end of the fourteenth century, known as *fan-vaulting*, and which presents a series of arch-ribs of the same curve, radiating from a single support, or axis. This fan-vaulting in the form of curvilinear concave cones, like the bell of a trumpet, consists of similar and equal ribs, between which are panels or soffits that are easy to fill in. I have elsewhere given a minute description of this kind of vaulting which can be so easily adapted to structure in iron. As machinery is now so extensively applied in the manufacture of large rolled iron, what should be avoided is the multiplication of patterns, which necessitates frequent changes in the operations of the workshop. A smith will make fifty pieces to the same pattern more cheaply and rapidly than if each piece required a special pattern ; and when it comes to the fixing there is less chance of the work not fitting, or of mistakes in it." See *Lectures on Architecture* (Vol. II., page 128), *translated from the French of E. Viollet-le-Duc, by B. Bucknall, architect, Lond.* 1881.

borrowed in the first instance from metal-work. A good deal of what he said was perhaps visionary, and could not meet with general acceptance, but the whole Paper was most ingenious and interesting. Beginning, I think, with Tubal Cain, he ended by showing us how the Corinthian capital itself was derived from what had originally been done in metal-work. This leads me to remark that if, as Mr. Stannus says, you cannot successfully imitate the foliage of an Early-English capital in wrought-iron you may produce a very beautiful Corinthian capital in that material legitimately treated. The hint Mr. Stannus gave for new forms in iron columns was a very valuable one, for instance (and as a mere suggestion) the ornamental shafts of an Early-English clustered column might be taken as the constructive ones leaving out the central column altogether, thus getting an appearance of efficient support with great lightness of effect. I noted with pleasure what Mr. Stannus said as to the necessity of designing downwards. It has been somewhere remarked, in illustration of this, that a competent architect can tell from the ground plan of a Gothic cathedral the manner in which it is intended to be groined and roofed—one of the first questions in every design must be "how are you going to roof it?" Possibly from want of time Mr. Stannus did not notice Spanish ironwork. It strikes me that this is a branch of the subject from which much may be learnt.

JOHN P. SEDDON, *Fellow.*—Mr. Stannus goes so thoroughly and artistically into every subject that he takes up, that I felt I should learn a great deal by coming to hear him this evening upon this important subject. I fear, however, I can only appear in the light of one of the critics of the material—at least I have been so hitherto. That is to say, I have never used iron if I could possibly help it. I have felt it ungainly and difficult to treat architecturally. I have endeavoured to do without it, and have pretty nearly always succeeded. I have generally tried to cover even large spaces without the use of it, and have almost always been able to do so to my own satisfaction. At the same time, since iron is a material which must be used largely, no doubt the way in which Mr. Stannus has taken up the subject is the one in which it should be treated, and ultimately by such means the ability of the profession will be brought to bear upon it with effect. At present it seems to be left very much in the hands of engineers, and that is simply because it has been used upon very large structures, which fall mostly into their hands. We talk, engineers and architects, as if we belonged to two distinct and separate professions—and unfortunately it is so—but we both deal exactly with the same materials, the engineers on a rather larger scale. The difference of the two professions seems to me to consist simply in that the one works with some consideration for beauty in view, and the other with none whatever. I suppose that if the question of iron were brought before the Institution of Civil Engineers, and any one spoke of treating the material beautifully, it would raise a laugh; whereas here smiles would greet the speaker who should venture to ignore that such consideration stood in the forefront. There ought not to be this division between the two professions, and practical utility and æsthetic treatment should be considered equally by both. For why should the largest structures of the day be monuments of ugliness and want of taste, as unquestionably they are? I have read M. Viollet-le-Duc's remarks on the subject, and they appear to me to be the least satisfactory part of his admirable treatises. While he was deducing grand principles from the old buildings we all felt he was our master, and leading us in the right direction, but this is

scarcely found to be the case in regard to these experiments with iron. Such buildings as he proposes of iron construction, plated with tiles for streets, are, I think, best left in his book; indeed, those experimental contrivances of domical roofings, supported by iron struts, exceedingly clever, interesting and amusing as they are, would be very unpleasant to sit under, supposing some accident to occur to knock a prop out, for then the whole structure would fall with a crash. If such a man as Viollet-le-Duc failed in this particular, I am afraid it will be some time before the dream of an iron style will be realized by us. Then it is to be remembered iron has not been just invented, but that the mediæval architects, who treated so admirably every material which they found worth taking-up, had iron, and would have used cast-iron more largely than they did if they had thought they could have done it advantageously. Their admirable works in wrought-iron are a proof that they could have dealt with cast had they desired to do so. We can only go safely upon the lines that they laid down, and had far better not leave them for such as some of the terra-cotta Italian Renaissance works brought before us to-night, which seem only to resemble iron in that they are remarkably skinny! Those who have dealt with this material have been hardly able to get away from the attempt to copy the circular column and Corinthian capital, whereas it appears to me to be entirely unnecessary to have capitals in ironwork at all. Then I do not know what spandrils are for unless for ornament, and therefore elaborate ornamentation of them may as well be omitted. As we have to cover-up the surfaces very much with paint, it seems as if it were better to treat them in the simplest manner, and trust to the effect of the colour which is so necessary an addition to them. If this subject, so admirably brought before us by Mr. Stannus, be thoroughly gone-into by architects, it must be by deducing principles rather than details from the old works, and by such means I own I think a great deal may be done with it. I do not, however, think it will fall to my lot to make the experiment.

CHARLES FOWLER, *Fellow*.—The lecturer objects to concealed joints, yet in one instance they produce a beautiful feature of the Gothic style, I mean the concealed joints of vaulting ribs by bosses. Another instance occurs in the building to which Mr. Stannus alluded—the Crystal Palace. There the joints of columns and girders are very scientifically formed, but they are carefully concealed. The joints were designed by the engineers, and the concealing was done by the architect. As to perforation I do not quite agree with the lecturer's remarks. He says that when the perforations are in wrought-iron they should form the pattern, but in cast-iron the iron itself should form the ornament, and not the perforation. My view is that the ornament should only be formed by the perforations when the surface is sufficiently large, so that you do not take in the outline of the surface itself. I do not see any reason why the material itself should not form the ornament. I will take, as an instance, a girder with so large a span that it is desirable to have it of a considerable depth, which makes a large rectangular surface. In that case I say that if the ornament is in the plate of a wrought-iron girder I agree with Mr. Stannus undoubtedly, but if in a cast-iron girder I do not see that it necessarily is different. Mr. Stannus thought it would be. If it is a large ornamental spandril, however, I do not think there is the same difference. I think in that case the material and not the perforation should form the ornament. For the reason stated: the outline of the whole spandril is taken into account. Passing to another point, Mr. Stannus suggested that in the Gothic capitals the abacus might follow more than it commonly does the outline of

the ribs or mouldings springing from it. I would remind him that, beautiful as is the Gothic treatment of the abacus, the ribs coming upon it were not often taken into consideration by the architects. One style made the abacus square, another octagonal, another circular with little reference to the shape of the ribs that come upon it. It was artistic instinct and not logical reasoning which led them to form the shape of their abacus. I should like to say in passing that I thoroughly agree with Mr. Stannus's idea as to designing downwards. The instance was probably in his mind of the Crystal Palace, where the design is obviously downwards. The roof was the original design, and the rest was worked-out from that. One word as to the legitimate use of iron construction. One particular instance occurs to me especially, and that is the concealing of iron in a concrete form and substance. The practice is very largely and successfully adopted, and I hardly think it can be called illegitimate. It seems to me that it may be very much extended, of course with proper consideration as to the form which should be adopted.

GEORGE ELKINGTON, jun., *Associate.*—I should like as one of the younger members to ask a question. If we are called-upon to design a building which is to be chiefly constructed of iron the Paper read would considerably assist us, but one of the main difficulties in the suitable treatment of iron arises where we are obliged to use it in conjunction with brick or stone, and other materials, as we have then to reconcile the apparently opposing systems of treatment best adapted for the different materials. Let us suppose we are called upon to build an ordinary house with a narrow frontage in a large town. We are obliged to use girders supported by stancheons at the side to give the owner the large window-space on the ground floor he requires for his business, whilst above that we are obliged to carry-out a front of brick or stone. Now is it admissible to conceal this girder and its supports? We can see this problem worked-out very unsatisfactorily in most of our London streets. Mr. Stannus also spoke of the beautiful terra-cotta and marble work seen in the Certosa at Pavia, and other buildings in North Italy, and I should like to ask him whether he would consider it a legitimate treatment as a variety to construct the whole façade of a house, such as I have mentioned, with a wrought-iron frame-work united to the interior construction, and then fix to it plates of cast-iron suitably ornamented, and possibly backed-up with concrete, in the same way that pieces of terra-cotta or slabs of marble are fixed in those buildings he named in the north of Italy. I do not think Mr. Stannus mentioned anything about riveting. I may incidentally mention that I heard a Paper read some time since at the Architectural Association, in which a great deal was made of the subject of ornamental riveting.

PROFESSOR KERR, *Fellow.*—The subject which has this evening been brought before us I have long regarded as one of the most difficult in the whole of modern architectural philosophy. It was all very well for Mr. Skidmore to talk about Tubal Cain, and tell us that all forms of architecture originate from metal work. This only reminds us of Vilalpanda, who declared that the Five Orders were handed down from heaven personally to Solomon, for the building of his temple. But, coming down from mere pleasantry, if we consider the use of iron in mediæval times as referred-to more particularly by Mr. Seddon, we must still acknowledge that this is entirely a different subject from the one Mr. Stannus has intended us to consider to-night. I apprehend Mr. Stannus's ironwork is the ironwork of architectural construction, as distinguished from the ironwork of ornamental art. This last is pretty well

understood, and has been well developed in many charming works and designs throughout various ages; but the ironwork of constructive architecture is a thing of our own generation. It has been frequently illustrated: chiefly by engineers, and occasionally by architects, and I think we must say, up to the present moment, without any success to speak-of. The question is this—supposing iron to be in some degree the material of the future (which is a point not easily determined in the affirmative), how ought it to be treated so as to display a reasonable amount of articulation, and thus be on a par with stone, timber, terra-cotta, and some other materials? This is a larger question than it may seem to be. It is a question of strict logic. It may have to be worked-out by what some gentlemen call "instinct," but artistic instinct is artistic logic, or nothing. Whether, however, it is to be worked-out successfully in our day or not, it is most desirable that we should try to deal with it, or at least to understand it; and it has occurred to me, while this discussion has been going on, that, as the Institute is now becoming a more wealthy body, it might be a good thing to offer a special prize for the solution of the problem generally—how to deal architecturally with ironwork, as a thing, I may again say, not yet attempted; or the question may at any rate be put thus, if no more: in what direction should our thoughts be turned in order to approach a solution? First, we may consider whether iron is likely to be to any great degree the material of the future. My own view is that I do not think so. I do not think it promises anything permanent, that is to say, quite satisfactory in the way of that long permanency which we attach to architecture of the highest class. There is the fatal objection of the oxide, especially in a climate like this, in which it forms so rapidly and is removed so readily. The use of paint upon the material is a most unsatisfactory way of preventing this process. We have no paint yet invented which accomplishes in any degree the preservation of iron in a practical, permanent way. The process to which Mr. Jennings referred has certainly been advertized a little, but I have never seen any exhibition of articles treated in that way which would profess to make it applicable for general use and on a large scale. We are still in the same position in which we have been so long in regard to ironwork—we must paint it with common oil-paint, and keep repainting it continually; and we all know, as architects, what that involves. In the first place it means the vulgarizing of the structure, and secondly an utter failure of the effort to preserve it from the action of the atmosphere. In a damp climate the wet inevitably finds access to the concealed parts of the ironwork and the joints that are free to move; and in the course of a few years we find the metal to be seriously damaged and, indeed, often dislocated. But at any rate the treatment of iron as ornamental work in Mediæval and Renaissance art being very common, and, as I have said, a great deal of good work having been done in that way, so that we have not to deplore any failure of human ingenuity so far, the broader question may be put thus:—How are we to construct a great railway station, for example, of ironwork, in the scientific way the engineers do it, but at the same time so designed as to be architecturally beautiful? The engineers, of course—and it is to their credit—do not pretend to treat it otherwise than structurally. Now we have, as it is commonly said, two kinds of iron—cast-iron and malleable. But that is not the best way to put the case. The two kinds are cast-iron and rolled-iron. We must look upon malleable iron for construction as rolled-iron; we must regard it as produced by that one process on a certain definite system, and not in any other way. In other words, it is only capable of being supplied to us within a very limited range of

forms. Then we have this most essential distinction: that cast-iron, as regards tension and compression, stands as one against compression to six against tension; whereas rolled-iron is as one to one—the flanges of a joist, for instance, are made equal—the iron is equally strong as against compression and as against tension. This distinction points to two different modes of designing in the material, not affecting beams alone, but all structural forms whatever. If we are to design either kind of iron-work aright artistically, it must be done on the basis of its own conditions; that is to say, unless it is regulated in every particular of form precisely on the basis of its own conditions, the design becomes delusive and a sham, and especially if the conditions of some other material are adopted. Thus it is that the handling of constructive iron-work architecturally on the basis of academical styles is an artistic blunder. Engineers' iron-work, as a rule, is not a blunder, simply because there is no attempt made to beautify it by academical rule. We must therefore primarily consider how cast-iron has been used in practical construction, and how rolled-iron has to be so used. Cast-iron is going out of use more and more, and so much the better, for it is a most treacherous material; but rolled-iron seems to have a great career before it. Well, taking either of these two materials strictly on its own scientific merits, I think we must then see that, in order to produce an architectural or constructively-artistic effect, there may perhaps be no very vast amount of ingenuity required if ingenuity were only started in the right direction. As Mr. Stannus has broadly hinted, we try to force upon iron those traditional and educational forms which belong to other materials. No doubt it is difficult, if not impossible, to dismiss from our minds the whole of the forms in which we have been brought-up, and which we have used throughout our lifetime, and therefore it is probably not to be expected that we can attain to a new and true system in the present generation, or even in two or three generations. But if iron continues to be used as it is now, something in course of time must certainly come out of it in respect of architectural treatment. The development of architectural art has always been extremely slow. This generation is a mere passing day in the world's development; the world was not made for us alone. We must not be in too great a hurry. It may take a century, or centuries, to do what we are speaking-of, but certainly, if we are to do anything in it at all, there is plenty of opportunity for us to try. A question was asked by Mr Elkington which I hope Mr. Stannus will answer in his general reply, namely, whether it is legitimate to construct a façade as a skeleton of iron-work, and hang upon it plaques of terra-cotta; an odd question, but I expect the answer will be—you may use what material you please, provided you use it properly. In illustration of the extent to which sham iron-work has gone, few are aware of the astonishing way in which it has been used in America. One notable example, not of a recent date—and living architects are not responsible first—is the Capitol at Washington. This edifice has a very large and fine central dome, surrounded by two noble classical peristyles of considerable magnitude; and I believe the whole dome and the whole of the peristyles, complete as they stand externally, are of cast-iron. When it comes to a case like this, I think we may say that surely human ingenuity ought to be able to do more than is indicated by such treatment. As engineers' work we shall say the construction may be perfectly balanced, and every strain algebraically calculated, but the ingenuity which has made of such a structure what it is, for the sake of merely presenting something classical to the educated eye, is wholly perverted. Take, on the other hand, the iron roof at St. Pancras

Railway Station, which was erected by Mr. Barlow, co-operative in some degree with Sir Gilbert Scott—the roof which we had under discussion some years ago in this room with great profit—that roof was carefully designed without any classicality or any mediævalism, and I affirm that it was capable of being made artistic, whether ornamentally or not, to any extent that might be desired. There are many persons who are perfectly satisfied with it as it is; and indeed, engineers are known to say they do not desire to have architectural effect. Take a common suspension bridge, which architects often consider to be one of the ugliest of all mortal productions; engineers say there are certain suspension bridges which are specimens of the perfection of beauty, because they are designed on principles of perfect utility alone, and do not require any ornament or any sophistication whatever. We are entitled, however, to plead that in iron-work as well as in stone-work, in the engineer's work as well as the architect's, grace ought to be always superadded to construction; and to prove this, I think, is the question now before us. I hope Mr. Stannus' Paper may awaken in our minds something like an earnest effort to examine into what can be done practically, at any rate with more precision than we have hitherto attained.*

C. FORSTER HAYWARD, F.S.A., *Fellow.*—I was almost surprised that in the Paper no reference was made to the artistic treatment of the iron-work carried-out at the Oxford Museum. A style was there attempted, and to a certain extent carried-out, with the help of Mr. Ruskin, and much interest was taken in it at the time, as it was executed by one of the best men of the day in artistic iron-work, namely, Mr. Skidmore. Probably Mr. Stannus will say how far he thinks that has been an advance, or otherwise, upon the principles which he is discussing. When he first spoke of the negative principles, which he insisted upon, I was inclined to go with him, as all of us should to a very great extent, but I think he almost went too far when he said that a moulding executed in a material of one kind should not be continued in another material, such as iron. I do not know whether he would strictly limit this to metal work, but of course there are forms in architecture which are as suitable in one material as in another, and have been adopted in all styles. If it is not so I should like to know how it is that the forms seen in the pediment, &c. of wood over the fire-place here are to be seen executed in stone outside, and in many other materials elsewhere. Again, if you have a series of columns in a room it would be a proper architectural treatment to continue some of the same mouldings and lines on the adjoining cornices or walls, if they came in a suitable position for the purpose. There is one peculiarity of iron-work, however, which causes it to take special architectural forms and proportions which has not been alluded-to, viz. the fact that a small column of iron will support a very large mass above, and this requires

* The extreme *artificiality* of rolled-iron is well worth reflecting upon. When the ore is smelted and the liquid metal flows forth into a mould, and is merely allowed to cool and granulate, the casting (even if it be the result of whatever amount of re-melting and mixing) is a sort of quasi-natural material; but when the same metal is refined and puddled, and skilfully pressed by well-directed forces until it no longer is a granular substance at all, but has been elaborately converted into a fibrous one—just as much as if stone were converted into wood—it seems as if a material had at length been discovered which thoroughly answers to the suggestion I have formerly ventured to make: that building, as a wholly artificial work of human invention, requires equally artificial materials to bring it to its intellectual best. The idea is more theoretical and abstract, of course, than in any way practical; but it may serve to direct attention to the peculiarity of the artistic problem here in hand, and to its particularly interesting character, as leaving speculation and invention, so to speak, singularly free and unfettered.—R. K.

careful artistic treatment. I found this out practically many years ago, in arranging for certain brick-work to be carried on supports to be made as small and unobstructive as possible. In the same way we have to design special forms for metal columns, carrying, say, the arches of churches, and this has led to caps and bases and decoration quite different from the usual Classic or Gothic forms, and also different from the forms used for carrying iron girders and arched pieces for roofs, as shown by Mr. Stannus's illustrations.* The ornamental treatment of iron girders, with their rivets and bolt-heads, has been successfully carried out, although on a small scale, at a certain building in the City, by Professor Kerr, who, in his modesty, did not allude to it, and I am sure our Chairman has many examples of the same kind of his own work in the City of London to which he could refer if he chose. Another point with regard to metal-work and the use of colour therein: how are we to treat it in connection with red brick, stone of various tints, and marbles? The proper artistic colouring of iron-work is a matter we have often discussed here, and which might be fairly taken-up in connection with this subject. If you have a girder exhibiting its construction and rivets, how are you to finish that in colour, so as to agree with the architectural features of the façade above it or in connexion with it? The engineers have tried this, and have gilded the rivets and other prominent parts, not attempting any flowing lines of ornament, but simply taking the lines of their construction. Upon the whole I think this simple and bold treatment has been successful. That is not the point, however, with us, who have very much smaller and more delicate work to carry-out. One mistake we may avoid—in using a band of metal-work of dark colour, such as forms a frieze round the Wellington monument, in St. Paul's, in direct contrast with white marble. In this instance it cuts the monument in two entirely, the upper part being quite separated from the lower by this deep, dark line of colour. This is, however, but an illustration of the importance of the subject of colour in connection with the forms of architecture, particularly with reference to metal-work.

THE CHAIRMAN.—Let me congratulate you in having called-up our friend Professor Kerr, who has delighted and instructed us. I am pleased almost to differ from him in one respect. One of the most useful modes of employing iron, to my mind, is its tensile use as to suspension bridges. I have seen them, and I have often thought that in many cases they have been charming items in the landscape. I cannot therefore regard them quite with the disfavour he has done. Again, I have always thought, and still think, that iron has to be treated very often as a distinct material, with distinct uses, to other materials. Let your supports be of solid stone or brick, or similar material, while your bearings and girders are of iron. Our art in all times is an accumulative and progressive art, certainly with iron more especially so. It is quite, you know, within all our memories: the first use of wrought-iron as a material for girders. I think almost one of the first floors with wrought-iron girders that was executed, I did some five or six and thirty years ago, and the girders were built by Mr. Finch, who at that time was contracting for the Chepstow Bridge, under Brunel. I think that very few wrought-iron girders had been executed before that, but since then there has been vast improvement and economy in the convenience, utility and safety of their construction.

* The resulting forms, however, are often in their proportion and decoration remarkably like some of the marble columns and their caps in St. Mark's, at Venice.—C. F. H.

HUGH STANNUS, *Associate.*—I have not alluded to means of protection from oxidation or to colour treatment, as I considered I explained that these lay outside the subject. I quite admit, as Mr. Blomfield remarks, that a very beautiful capital may be produced by adding wrought-iron leaves to a core, but this treatment would not do for out-door purposes, as the leaves would form cups for water to collect, which would soon destroy them by oxidation. I very much admire the Spanish work, as far as I know it from the fine collection exhibited lately at the South Kensington Museum; but I could not treat upon it this evening, as it was not constructional, but rather decorative. I beg to deprecate the word "prop," used by Mr. Seddon. I believe, moreover, that if he "knock the props out" which support the roofs of the Chapter-houses at Westminster, and elsewhere, the results would be similar to those he suggests. He says the mediæval architect had iron, and did not use it constructively for large features. I venture to suggest that this is scarcely correct—roofs and other large structures are only possible with *rolled iron;* and Henry Cort, the inventor of rolling, died only a few years ago. Again, the art of making castings *sufficiently large* to bridge over a fairly large opening is also a thing of our time. The mediæval architects, therefore, did not possess iron fit for their purpose, and no argument can be founded on their not having used iron more largely. Probably they would have used it if they could have commanded pieces of sufficient magnitude: then the problem presented by rust and vibration would have been met and solved, instead of our having to face them now. I certainly did object to concealed joints, but I do not think, in the instance deduced by Mr. Fowler, the boss was used for the purpose of concealing joints, but rather to conceal the imperfect mitres of the vaulting-ribs. I beg to thank these gentlemen and the others, especially Professor Kerr, for their kind observations, and the additions they have made to our common stock this evening. I cannot help feeling, however, that this is an incomplete discussion: when the honour was done me of inviting me to read this Paper I was in hopes of having myself the benefit of the accurate observation, ripe judgment and deep knowledge of one who is no longer with us. This loss, common to us all, is acutely felt by me, and I can only express my regret that the sudden death of Mr. Street has deprived us all of what I should call the complement of this brief discussion.

VII. UNIFORMITY IN BUILDING AND SANITARY REGULATION.

By Mr. Joseph Boult (Liverpool).

[Read on Monday, 6th February, 1882, Ewan Christian, *Vice-President*, in the Chair.]

PROBABLY few persons, even among architects, are aware of the extent of architectural jurisprudence, including in that term, not only the laws and by-laws which control the structure and arrangement of buildings, but the statutable and *quasi*-statutable provisions which affect the easements of landed property, the laying out of land for building purposes, cemeteries, the assessment of property for rating purposes, and compensation for various kinds of disturbance, as well as the rules of departments which must be observed in the erection of churches, school-buildings, prisons, workhouses, and other erections. The purpose of this Paper is the consideration of some of those regulations which govern the supply of buildings of various kinds, including essential sanitary provisions.

Architects and others about to build have to be acquainted with an indefinite number of existing codes, according to the place in which the erection is situated. In some parts of the country their discretion is absolutely unfettered by any local authority; in others there are a number of conterminous jurisdictions without any apparent separation obvious to strangers; and the respective regulations vary capriciously.

Mr. Rawlinson, C.B., has most courteously informed me, in reply to an inquiry, that there are altogether a thousand urban authorities, including, I assume, municipal corporations, and 600 rural authorities; that nearly all the urban and about 180 of the rural authorities have framed by-laws for regulating the laying-out of streets and the erection of buildings. The Local Government Board has power under sect. 276 of the Public Health Act, 1875, to permit any or all of the other rural authorities to exercise similar powers, as though they were urban authorities. Thus the number of varying codes may be increased to not far from two thousand.

That regulations, for securing similar objects in the same country, should be as uniform as possible is so obvious, the Local Government Board have had prepared and issued a code of Model By-laws* for the guidance of local authorities. The only apparently valid objection to absolute uniformity, such as is found in other branches of jurisprudence, arises from local peculiarities of site, material and usage. With a view to these difficulties the Public Health Act, 1858, sect. 34,†

* At the General Conference of Architects, 1878, Mr. J. Douglass Mathews read a Paper entitled "The Model Bye-laws as a basis of a General Building Act." It will be seen on reference to that Paper, printed in the Transactions, 1877-78, p. 277, and to the Report of the Council on the subject, printed at p. 294 of the same volume, that many of the questions treated by Mr. Boult have been previously raised and discussed by other architects and scientific men.

† The Public Health Act, 1875 (38 & 39 Vict. c. 55), more recently provides, under Section 157, that "every urban authority may make by-laws with respect to the following matters: (that is to say,) (1.) With respect to the level, width, and construction of new streets, and the provisions for the sewerage thereof; (2) With respect to the structure of walls, foundations, roofs, and chimneys of new buildings, for securing stability and the prevention of fires, and for purposes of health; (3.) With respect to the sufficiency of the space about buildings to secure a free circulation of air, and with respect to the ventilation of buildings; (4) With respect to the drainage of buildings, to waterclosets, earthclosets, privies, ashpits, and cesspools in connexion with buildings, and to the closing of buildings or parts of buildings unfit for human habitation, and to prohibition of their use for such habitation."

empowered Local Boards to frame by-laws, with respect to the laying-out of building land, drainage, and the structure of walls for securing stability, and the prevention of fire; but the by-laws required confirmation by the Secretary of State before they could be enforced. After the lapse of more than twenty years, with the assistance of upwards of a thousand urban and rural authorities, it appears not unreasonable to assume all local peculiarities may be duly allowed-for in a General Act.

Taking casually the By-laws of three districts, within four miles of the Townhall in Liverpool, I find the thickness of walls required in one to be as prescribed in the Metropolitan Building Act, 1855; in another, as required by the Liverpool Building Act, 1842; and in the third, "as shall be approved by the Local Board." It will be conceded by all, that these anomalies should disappear, and all practicable uniformity be substituted.

With uniformity simplicity should be combined, so that the number of regulations may be few and easily understood. At the same time it must be conceded that technical phraseology is not easily understood by those to whom it is unfamiliar; and that technicalities are essential to the precision requisite in legal enactments. From this cause it has been found desirable to compile various manuals for easy reference, in which are inserted not only explanatory comments by the learned compiler, but also the decisions of courts upon cases submitted to them. Were there a uniform and general statute for regulating the provision of dwellings and other buildings, it cannot be doubted similar manuals would be prepared for the use of architects and builders; assistance they cannot receive while the multitude of enactments is so great and varying. Such manuals would properly include those details of walls, timber and concrete, which are so embarrassing in Acts of Parliament and by-laws, through the obscurity caused by verbiage and repetitions inseparable from legal enactments. Put into formulæ and tables such details would be more readily comprehended.

Essentials v. *Non-Essentials.*—A survey of some of the numerous Acts of Parliaments and sets of by-laws clearly shows there is great anxiety to protect the public from structural and sanitary defects; consequently many of the requirements are so very minute as to assume the appearance of frivolity, and cause irksome interference with the natural laws of supply and demand.

My opinion is that the speculator, who provides a number of dwellings, is just as much a manufacturer as the shirtmaker or hatter; and that it is desirable to leave his trade as free and unfettered, provided the public do not suffer in health, stability, or excessive liability to fire. There is no greater necessity for supplying men with thoroughly good houses, than with thoroughly good food, or thoroughly good clothing. It is not at all impossible that the public health is more influenced by food and clothing than it is by dwellings; the immunity usually enjoyed by the clergy and medical men, who visit fever-stricken districts, to some extent lends probability to this suggestion.

The laudable desire to prevent defects in dwellings appears to have induced confusion as to the relative importance of things essential and of things desirable.

As suggested above it is desirable all should have a sufficiency of wholesome food and clothing, but daily experience shows there are millions who not only live, but actually thrive, with very defective food and clothing, and even without any clothing at all. Among numerous savage races may be found an indefinite number of examples. Therefore, among the principles

to be observed in structural legislation, the first is to avoid the mixing-up of essentials with matters only desirable, however desirable they may be.

If this principle be recognized and adopted the Model By-laws issued by the Local Government Board, and other provisions for similar purposes, would lose, on revision, much of that minuteness which causes them to resemble a carefully prepared specification.

In a building contract it is necessary to have the conditions of all kinds carefully specified, so that each party may know his liabilities. At the time it is prepared, a specification is supposed to include the latest available improvements; nevertheless, it is sometimes found expedient to deviate from its provisions, in order to adopt improvements not fully known when it was prepared. Whilst a specification is a temporary document, having a vitality which seldom exceeds two or three years, an Act of Parliament is supposed to endure for ever. The arts of building, however, are progressive, and continually changing with the application of new materials, or with new applications of old materials; and it is very undesirable that progress should be impeded by restrictions not absolutely needful. It may, indeed, be said that intelligent authorities will be ready to modify their regulations, as the arts are improved, just as the Metropolitan Board of Works has with regard to Portland cement concrete. But it must not be forgotten that the proof, that such concrete is suitable for building purposes, could not be acquired in the metropolitan district, so long as its use was disallowed, nor in any other district subject to similar restriction. Thus inventors and adapters would be discouraged from experiments essential to the perfection of their improvement; and with progress it is difficult at all times to distinguish between experiment and experience. It would often be impossible to prove the fitness of a novelty until subjected to actual experience. Portland cement concrete had been used as a building material before the Metropolitan Board could frame regulations under which its use is sanctioned in the district; the Board was guided by actual experience elsewhere. The very limitation of the privilege to Portland cement concrete tends to prevent the invention or adoption of any other concrete. It is conceivable some material, not Portland cement, which is itself still somewhat novel, may be presented possessing advantages peculiar to itself, but the people of the Metropolis are prevented from its use, until its merits have been established elsewhere: this consideration, as far as it goes, is against a statute applicable to the whole country, but it loses its force if the statute is framed on general principles, which leave trade as unfettered as is consistent with the common weal.

As regards Portland cement itself the manufacture may be so improved that a "striked bushel" may be capable of bearing, under the prescribed conditions, a greater weight than 350 lbs. per square inch, and of concreting a larger mass of raw material; but the improving manufacturer will be deprived of the fair advantage to which he is entitled against his established competitors, until he has satisfied the authorities of the superiority of the new article. Where and how is this to be done?

Again, in framing regulations for the use of concrete in houses of certain moderate dimensions, the Metropolitan Board has restricted that use to some one or other of the processes now in use for concrete building, thus assuming there can be no others suitable. Therefore improvement is discouraged in that direction also; for every impediment in the way of adoption is discouraging. Nor is it clear that, with the present modes of construction,

the use of concrete should be restricted to houses of certain moderate dimensions; there are various structures for trade purposes in which it may be used advantageously.

Even in the present state of concrete manufacture, it is not apparent why its use in building should be restricted to some one or other of the processes in use. Concrete is really an artificial stone, in some respects very superior to many natural building stones; in blocks it has proved an admirable material for harbour works, and other structures exempted from the provisions of the Metropolitan Building Act; and there does not appear any sufficient reason why the use of concrete blocks, instead of freestone, should not be permitted freely. It may be possible in some places to manufacture bricks of Portland cement concrete at a price to compete with or to supersede burnt clay; and as the word brick is not defined as to material or size, it would be possible to build a wall of concrete bricks, instead of in one solid block.

I have failed to discover any requirement in the Metropolitan Building Act, or in the By-laws issued by the Metropolitan Board, that the bricks, stone or other substances of which walls are built, shall be other than hard and incombustible. Nor is there any provision as to the quality of the mortar or cement, with which those substances are to be solidly put together, a laxity in remarkable contrast to the restriction imposed upon Portland cement concrete.

It would be interesting to know why the Metropolitan Board is so minute as to the quality of Portland cement concrete, and so indifferent as to bricks, stone, mortar and cement therewith, as not to require they shall be even good. For outbuildings, dormer-windows, porches and other structures, concrete slabs, secured to pillars or stanchions of the same material, or of iron, are unobjectionable.

I have dwelt upon this topic at the risk of being tedious, because the regulations referred-to are typical, and illustrate that tendency to excessive and, at the same time, unequal precaution, which appears to pervade almost all building and sanitary legislation, and imposes most irksome and very unnecessary restrictions upon important branches of trade. The Model By-laws and the Metropolitan Building Act are both silent as to the quality and strength of timber used in structures; though surely their stability depends to a considerable extent on the timbering. This omission seems to indicate a consciousness that the building trades, as far as possible, should be unfettered.

Laying-out Land for Building.—Sanitary science, as distinguished from the art of healing, is the art of preventing disease—that is, of preserving health; therefore, its sphere is very wide, and its action governed by many influences, the proper gradation of which it seems at present impossible to decide. I have already invited attention to the importance of good, wholesome food and clothing in suitable quantities; other influences, which ought not to be disregarded, are the various employments and habits, including in the latter vicious self-indulgence. There are many processes which render it impossible for those engaged in them to practise habits of personal cleanliness; and so an example is introduced into a family which tends to produce, and doubtless in some cases does produce, habits utterly incompatible with personal and domestic cleanliness. To these considerations may be added the difficulty of maintaining cleanliness in crowded dwellings, in which several families share one house of moderate or small size, or in which each apartment is the living-room and bed-room for a whole family. It is true, one of the cleanest dwellings I ever saw was an apartment occupied by a married couple and six children, the eldest a boy of sixteen. Though poorly furnished, and with only one bed, most of the children sleeping on chairs or the floor, it appeared

thoroughly respectable, in the true sense of the word. This, however, is a very exceptional case; but it serves to show that the term overcrowding is very much abused, for the family was healthy; and from various public institutions, as well as from model dwellings, examples may be drawn, which prove that crowds may be very healthy. Model lodging-houses and dwellings have shown that a population of 1,500 people per acre may enjoy excellent health, whilst numerous parts of our large towns, with only one-fifth of that density, are dens of fever and misery. One eminent sanitary philosopher has asserted, it is desirable to limit the density to five families on each acre, but has omitted to calculate the space which would be left for agriculture, mining and trade, if the population of England and Wales were so distributed. The fact appears to be that density of population is to be measured by cubic space, and not by area; and cubic space may be indefinitely expanded by ventilation and cleanliness.

These appear to me important facts in connexion with the laying out of streets and the provision of domestic buildings, especially for the very poor. Every additional item in the cost of a house, which, however desirable, is not essential, increases the difficulty of providing necessary accommodation for the helplessly poor; so every distribution of land not consistent with wise economy, and all structural requirements not absolutely indispensable, should be carefully avoided. Thus it appears, building and sanitary regulations on this ground also should "avoid the mixing up of essentials with matters only desirable, however desirable they may be." Therefore, the language of those enactments should be as general as is consistent with precision and explicitness.

Unbuilt Areas.—By the Metropolitan Building Act, a dwelling-house, unless its rooms can be lighted and ventilated from a street or alley adjoining, is required to have at the rear or side an open space, exclusively belonging to it, of at least 100 square feet.* In that Act the term dwelling-house appears to have the same signification with domestic building in the Model By-laws. This clause is by no means oppressive, for, if any space is to be retained, it could not well be less; but, as far as my observation goes, small open areas, instead of being conducive to health, become harbours for accumulated filth, which, being constantly damp, through exposure to rain, frequently ferments and generates noxious effluvia. Besides, such a requirement is a hindrance to the erection of dwelling-houses in flats, either for residence or for business purposes, as it is difficult to subdivide the space so as to give each tenement its exclusive portion, and the number of tenements may vary from time to time. In the building in Liverpool which Professor Cockerell esteemed his *opus magnum*—Liverpool and London Chambers—he provided an internal court covered with a glass roof; the plot of land is bounded by four streets, and thus between the court and each street are two rooms in depth, both well ventilated and well lighted. The inner court, being protected from inclement weather, is very useful, not only for ventilation, when the windows next to the streets cannot be used, but also as a means of communication to and from all parts by galleries. The rooms next the court have the great advantage of being quiet, those next the street being exposed to the annoyance and interruption arising from continuous traffic. Much dust seems also to be excluded from the apartments in the court.

Other instances might be adduced in which similar advantages have been secured in like manner; and it appears to me such arrangements are very preferable, on sanitary grounds, to

* See Section XXIX.—Every building used or intended to be used as a dwelling house, unless, &c.

the requirements of either the Model By-laws or of the Metropolitan Building Act. In dwellings for the very poor, I consider small open yards are frequently very offensive, and always objectionable; but if they were protected from the weather, they would be very useful for the rougher parts of domestic cleanliness. When inmates are protected by roofs, verandahs and porches, I observe they are usually ready to keep the external doors habitually open, which must tend to render the dwellings less insalubrious. Even without such protection, the entrance-door in many houses occupied by the very poor is seldom closed, except during the winter; and many women may be observed sitting on the thresholds, and children standing or playing out of doors. This would be even more habitual than it is, if access were given to large, airy covered courts or sheds.

So long as it is necessary for people to follow their daily avocations there should be as little interference as possible with the convenience of the public; and, instead of requiring the dedication of property to vacancy and neglect, that convenience would be better secured, when practicable, by greater width of street, especially in back alleys and narrow slums. Besides, it is useless to provide the means of ventilation for people who are not sufficiently intelligent to make use of them. Any one may observe how very seldom the windows of most houses are open, even for a few minutes; and generally speaking the smoke-flues inside the several apartments are closed by registers, chimney-boards and straw wrapped up in old carpets. A few years ago I took notice that in forty-eight houses only about a dozen windows were open, and most of those had the lower sash only raised, instead of having the upper sash lowered. The thermometer stood at 45°, the barometer was rising, and there was a light breeze, without dust; the street is free from noisy traffic. Of the houses, nineteen were occupied by medical practitioners and five by dentists, dental surgeons, oculists and chiropodists; thus one-half of the houses was tenanted by scientific men, who may be supposed to have more than the average information on the importance of pure air, and to be as intelligent as most of the middle classes. If men with their advantages are so careless and negligent, it cannot be surprizing if others less favoured should not only neglect the means of ventilation, but rigorously exclude every perceptible current of air, however slight, especially when they are insufficiently clothed and insufficiently fed. This is another illustration of the fact, too often neglected, that the reformation of bad habits is more the work of the individual than of the community. I do not doubt that, on the whole, the rate of mortality is influenced more by personal habits than by structural arrangements.

The Model By-law No. 58* requires in every habitable room in a domestic building which is without a fireplace special and adequate means of ventilation by a sufficient aperture, or air-shaft, with an unobstructed sectional area of at least 100 inches. Upon this it may be observed that the area of an ordinary fireplace flue is only 126 inches, clear of the brickwork, which is reduced by parging; when flue linings, 11 inches in diameter, are used, the area is but 95 inches, many linings being of less diameter; and that the least area of an ordinary chimney-pot seldom exceeds 50 inches, or one-half that specified for the ventilating aperture

* *Model By-law* 58.—Every person who shall erect a new domestic building shall cause every habitable room of such building which is without a fireplace, and a flue properly constructed and properly connected with such fireplace, to be provided with special and adequate means of ventilation by a sufficient aperture or air shaft which shall provide an unobstructed sectional area of 100 *square inches* at the least.

in a room without a fireplace. One hundred inches is also out of proportion to the chinks and crevices which are the complement of the shaft or aperture, as they supply the fresh air which, after pollution, is to pass away. Doubtless, in the great majority of cases, the occupier of the room will close the aperture with an old newspaper, or otherwise. Comparing this By-law with No. 59,* by which a public building is required to have adequate means of ventilation, one is tempted to inquire why the language used in both should not be identical.

Various provisions in the Model By-laws, the Metropolitan Building Act, the Towns' Improvement Clauses Act, and in provincial Acts and By-laws, appear due to two conspicuous and deplorable causes: first, to the absence of careful and systematic inquiry into the reasons why certain urban and suburban districts are especially healthy or unhealthy; and, second, to foregone conclusions, which have been proved by experience to be fallacious and untrustworthy. In Liverpool, for example, the use of water-closets is compulsory, and privies are not allowed; in Manchester the use of water-closets is discouraged, and privies are almost universal. Which system is most conducive to longevity? or has either produced the slightest effect on the rate of mortality? It does not appear that either can claim advantage, the rate of mortality being about the same in the two cities.

Damp-course.—There appears to be an absence of practical familiarity with building operations in the By-law † framed under the Metropolitan Management and Building Acts Amendment Act, 1878, and the Model By-law No. 17. ‡ The first prescribes that in external walls the damp-course shall be at the height of 1 foot above the level of the ground abutting directly upon them; and in party or internal walls at a level not less than 6 inches below that of the lowest floor. The least experience shows that a damp-course, to be effectual, should be continuous, that is, at one level throughout the structure; if it is not, but placed as specified above, the damp, which is prevented from rising in the party or internal walls of a basement storey, will be able to rise in the external walls, and thence, through capillary action, to spread laterally into the adjoining walls.

Again, in all the leading business streets of most towns, it is an object with tradesfolk to keep the floors of their shops very near to the level of the pavement: in many cases the shop-floor is flush with the highest part of the adjacent pavement; in a few the floor is actually below the pavement. In such cases a damp-course, 12 inches above the pavement, would lose very much of its presumed efficacy. If the shop-floor is carried upon wooden joists they would not be protected by the damp-course.

The Model By-law is admirably obscure. It prescribes a proper damp-course in every wall beneath the level of the lowest timbers, and at a height not less than 6 inches above the surface of the ground adjoining such wall. It is to be assumed, from the expression "such wall,"

* *Model By-law* 59.—Every person who shall erect a new public building shall cause such building to be provided with adequate means of ventilation.

† "Every wall of a house or building shall have a damp-course throughout its whole thickness, of asphalte or other material impervious to moisture. The damp-course in external walls shall be at a height of 1 foot above the level of the ground directly abutting upon the external wall, and in the party or internal walls at a level of not less than 6 inches below that of the first floor."

‡ *Model By-law* 17.—Every person who shall erect a new building shall cause every wall of such building to have a proper damp-course of sheet lead, asphalte, or slates laid in cement, or of other durable material impervious to moisture, beneath the level of the lowest timbers, and at a height of not less than 6 *inches* above the surface of the ground adjoining such wall.

that the damp-course is not to be continuous throughout all the walls, or the expression would have been "such walls." Therefore, where the front and back of a building abut upon streets at different levels, the damp-course will probably be at three levels: one in the front wall, another in the back wall, and a third in the internal walls; and should the building be at the corners of a side street, connecting the front and back streets, the number of levels becomes indefinite, according to the inclination of the side street, and the manner in which the lowest timbers are stepped.

In By-laws recently proposed by the local authority in Liverpool, it is specified there shall be a damp-course, extending through the length and breadth of every new wall, at or near the level of its base; and that the same, or another similar damp-course, shall be at least 4 inches above the surface of the external ground, and beneath the level of the ground-floor joists; but the latter may be dispensed-with provided there is a continuous vertical cavity formed in the thickness of the wall. These last provisions obviously apply to external walls, but the word external has been omitted. Where vaults under the side-walk, or areas for light to basement, extend across the whole frontage abutting on the street, it would appear both damp-course and cavity are superseded.

Referring again to shops, if the damp-course is placed 4 inches above the level of the adjacent street, and under the ground-floor joists, it is clear there must be at least two steps from the street into the shop, which will be a serious disadvantage to any shopkeeper, who rebuilds his premises in which the former floor was level with the street.

I believe the local authority in Liverpool, not having been able to have their proposed by-law sanctioned, have included the provision I have quoted in a bill, of which they have given notice for the next session of Parliament.

The three levels, prescribed by three authorities for the level of a damp-course in external walls, exemplifies the difficulty of framing such provisions on the model of an architect's specification. A general regulation, that suitable or efficient precautions shall be adopted to prevent damp from the soil from rising into any wall, appears to meet the necessities of the case.

Foundations.—Wherever the site of a proposed building is of an objectionable character, which cannot otherwise be neutralized, the use of concrete or asphalte all over the site may be highly desirable; but the Model By-laws specify asphalte or cement-concrete, whilst the Metropolitan By-law permits the use of either lime or cement in the concrete, and does not recognize asphalte at all: and where the Model By-law No. 10* merely requires good cement-concrete, the Metropolitan By-law specifies the materials with which the lime or cement must be mixed. Again, the Model By-law requires the cement-concrete to be used upon every site, and the Metropolitan by-law exempts gravel, sand or virgin soil. I confess to being somewhat perplexed by the last exemption, seeing that the Metropolitan district includes a large extent of marsh and swampy land, where, if anywhere, I should otherwise expect the use of concrete, perhaps cement-concrete to be enforced. These discrepancies between authorities so eminent is a further illustration of the difficulty of framing minute rules of the kind; they appear to

* *Model By-law* 10.—Every person who shall erect a new domestic building shall cause the whole ground surface or site of such building to be properly asphalted or covered with a layer of good cement concrete, rammed solid, at least 6 *inches* thick.

indicate the wisdom of using more general language, such as that every site shall be thoroughly drained, and every building erected on a good solid foundation, artificial or otherwise; where requisite the site shall be covered with asphalte, concrete or other suitable material, sufficient to prevent the passage of damp, vapour or noxious exhalation.

Drains.—The propriety of covering drains with concrete is part of a very wide and important subject, which had better be treated as a whole, rather than in sections; the material, size, mode of laying, flushing and ventilating of drains, are all items worthy of more intelligent consideration than they appear to have received from the framers of various enactments. The first condition, governing every system of drainage, involves the fact that all parts of the building are above the sewer into which its drainage is to be discharged. To this end the Model By-law No. 61 prescribes that the lowest storey shall be at such a level as will allow of its effectual drainage into any sewer, or other means of drainage, with which it may lawfully communicate. A prior consideration again suggests itself, whether the local authority should not be bound to lay the sewer at such a depth as will give all reasonable facility for removal of drainage.

I am acquainted with more than one case in which owners of property were put to the outlay of several hundred pounds each, because the public sewers adjacent to the respective properties had not been laid low enough. In one case the drain had to be diverted from the nearest sewer into another four hundred feet away: the whole course of the diversion lying within the curtilage of the property; at that distance it was connected with a continuation of a public sewer, that continuation being made at the owner's expense, from a point to which the sewer had been constructed for the drainage of the Town Hall. It may generally be assumed no one will sink his building further than is likely to be remunerative. There are, doubtless, places in which it is impracticable for sewers to be laid much below the surface of the street, but then it is equally impracticable to carry buildings down: and a proviso that every building be properly drained appears a sufficient check on any imprudent wish for excessive depth.

With regard to the material of which drains and public sewers should be constructed, all, I think, will agree it should be impervious to air and water; therefore, that ordinary bricks are not suitable, unless they are rendered, on the invert especially, with good cement or other impervious material. The use of clay pipes is also open to serious objection from the multiplicity of joints, as well as from the difficulty of insuring a perfect joint, that is, one which is close and free from irregularities on the inner surface. A very small protuberance of cement, or other material, may cause a serious obstruction or even stoppage. Paper, rags, cotton-wool and other fibrous products readily adhere to irregularities, and form the nucleus of dams, which gradually close the passage. A similar result may arise from the injudicious use of traps, as their tendency is to impede the current, and to cause deposits. This liability is a cogent reason against placing drains within a building site, except where practically unavoidable, and in favour of facility of access. The necessity for that access has led to the introduction of saddle-pipes, which are a very useful provision against delay and excessive expense in the removal of obstruction. This necessity for ready access to drains presents an insuperable obstacle to the covering of good solid concrete, at least 6 inches thick all round the drain, as required by the Model By-law No. 62.* It is oftentimes impossible to

* *Model By-law* 62.—Every person who shall erect a new building shall, in the construction of every drain

ascertain in which part of a drain the obstruction is to be found, until an opening has been made; when found it may frequently be removed by implements of cane or strong wire; where available a man's arm is the most handy appliance.

The difficulty of securing the proper execution of work in drains and sewers is so very great I am disposed to think that, among the materials at present available, good cement-concrete is the most suitable for inverts. It would be easy to ascertain in imperfect light, or even in darkness, whether the surface is as smooth as necessary, by simply passing a hand over it. The upper part might be of the stoneware so generally used; the bottom edges being tongued into a groove on the top of the concrete: this would give a double lap to the joint, and with the addition of good lias mortar or cement would be impervious. Then, with saddles for drains, and manholes for sewers, the requisite access would be gained, an access which can be secured after each entry.

The purpose of traps in drains seems as yet to be very imperfectly understood by those to whom are intrusted the precautions of sanitary science. As before observed, every trap tends to check the current, and to cause deposit and obstruction. I have had to remove traps on that account: consequently the introduction of traps should be guided by intelligence, caution and judgment. The purpose of traps is to prevent the passage of emanations likely to be prejudicial. It is obvious the first responsibility rests with the authority by whom the sewer and outfall are provided, who is bound to keep that sewer, as far as practicable, clean and sweet. For, if the sewer be badly designed and constructed—if it be not properly ventilated—and if it be not properly cleansed by flushing or by hand, it becomes a reservoir of decomposing filth, continually generating noxious miasma. The more cleanly a sewer is kept, the less necessity for ventilation; and the more perfect the design and execution of the sewer, the less necessity for cleansing processes.

The object of ventilation also appears to be imperfectly understood. I regard it as a preventive and not a curative agent; that is, it is intended not to permit sewer-gas and effluvia to escape without doing injury, but to prevent sewer-gas and effluvia from coming into existence. The free access of atmospheric air tends to prevent that fermentation which generates sewer-gas and effluvia. By desiccation and by other oxygenizing processes, due to one of the constituents of the atmosphere, fermentation is prevented. By the decomposition of the atmospheric air within the sewer, the noxious decomposition of the

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of such building, other than a drain constructed in pursuance of the by-law in that behalf for the drainage of the subsoil of the site of such building, use good sound pipes formed of glazed stoneware, or of other equally suitable material. He shall cause every such drain to be of adequate size, and, if constructed or adapted to be used for conveying sewage, to have an internal diameter not less than 4 *inches*, and to be laid in a bed of good concrete, with a proper fall, and with water-tight, socketed, or other suitable joints. He shall not construct any such drain so as to pass under any building, except in any case where any other mode of construction may be impracticable, and in that case he shall cause such drain to be so laid in the ground that there shall be a distance equal at the least to the full diameter thereof between the top of such drain at its highest point and the surface of the ground under such building. He shall also cause such drain to be laid in a direct line for the whole distance beneath such building, and to be completely embedded in and covered with good and solid concrete, at least 6 *inches* thick, all round. He shall likewise cause adequate means of ventilation to be provided in connexion with such drain at each end of such portion thereof as is beneath such building. He shall cause every inlet to any drain, not being an inlet provided in pursuance of the by-law in that behalf as an opening for the ventilation of such drain, to be properly trapped.

sewage is prevented; and the sewer does not become a still for extracting the pabulum of disease-germs. Where practicable, it is desirable the ventilation of drains should assist in the ventilation of sewers, so that the circulation of atmospheric air in sewer and drain may be as copious as possible.

Thus the proper position for a ventilating outlet from a drain is between its trap and the sewer; it then acts as a safety-valve, to relieve the trap from the pressure of any sewage-gas, which naturally passes away through the channel of least resistance, that is, the outlet. If the ventilating outlet be on the other side of the trap, that is, between the trap and the building, its influence tends to weaken the trap, by drawing the sewer-gas through the water, before it can escape by the outlet; the water is thus befouled, the seal evaded, and the trap destroyed.

From the preceding remarks it would appear that—

1. Traps should be placed as far as possible from the outfall, and as near as possible to the infall, so that the water discharged may pass away with the utmost possible momentum and velocity.
2. The connexion between the infall and the sewer should be unbroken by any communication with the external air, except the ventilator external to its trap, so that the passage of atmospheric air from the sewer to that ventilator may be as rapid as possible.
3. Wherever practicable, the pipes which convey refuse into the drains should be used for ventilation.

Even when the water discharged through a ventilating pipe from the roof, or a lavatory, is but small, it is still useful, because, descending in a spray like lead in a shot tower, it causes agitation and motion in the air with which it comes in contact.

I consider every system of drains should be provided with the means of flushing all its branches. In places supplied with pipe-water drains may be conveniently flushed by inserting the nozzle of a hose in connexion with a hydrant; and local authorities should be required to flush all drains at least twice a year, say at the beginning and end of summer, also at the end of every drought or severe frost.

The Model By-laws contain two somewhat elaborate schemes for the ventilation of drains, of which it may be said neither of them is practicable in all circumstances. The framers have adopted assumptions which appear to me not only undesirable, but extremely objectionable. The first is, that a suitable trap shall be placed within the curtilage of the building in every drain, which may communicate directly with any outfall, at a point as distant as may be practicable from the building, and as near as may be practicable to the connexion with the outfall; and, second, that there will be space between that trap and the building for the introduction of an opening at or near the surface of the ground, which shall communicate with the drain.

Now, in places where land is very valuable, as in the city of London, it is usual for a building to cover the whole site, and, therefore, not to have any of the curtilage available for such an aperture and trap, as are required by the Model By-laws Nos. 63 and 65;* so where

* *Model By-law* 63.—Every person who shall erect a new building shall provide, within the curtilage thereof, in every main drain or other drain of such building which may directly communicate with any sewer

the building abuts upon the street, under which is the sewer, with which its drains are connected, there is clearly no space within the curtilage for the aperture and trap. The aperture is obviously intended as an inlet for air.

Further, a vertical outlet is required at a point as far as possible from the aperture above-mentioned, not less than 10 feet high, and so carried up as to prevent the escape of foul air into any building in its vicinity. Thus a certain amount of ventilation will be secured, but it is to be feared that amount will be very inadequate, seeing the trap will check the flow of drainage, and tend to produce an accumulation of filth, the fermentation of which is likely to be in excess of the means provided for its prevention and amelioration.

In the description of the second scheme there appear to be two singular oversights:

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or other means of drainage into which such drain may lawfully empty, a suitable trap, at a point as distant as may be practicable from such building and as near as may be practicable to the point at which such drain may be connected with such sewer or other means of drainage.

Model By-law 65.—Every person who shall erect a new building shall, for the purpose of securing efficient ventilation of the drains of such building, comply with the following requirements :—(i.) He shall provide at least two untrapped openings to the drains, and, in the provision of such openings, he shall adopt such of the two arrangements hereinafter specified as the circumstances of the case may render the more suitable and effectual. (*a.*) One opening, being at or near the level of the surface of the ground adjoining such opening, shall communicate with the drains by means of a suitable pipe, shaft, or disconnecting chamber, and shall be situated as near as may be practicable to the trap which, in pursuance of the by-law in that behalf, shall be provided between the main drain or other drain of the building, and the sewer or other means of drainage with which such drain may lawfully communicate. Such opening shall also in every case be situated on that side of the trap which is the nearer to the building. The second opening shall be obtained by carrying up from a point in the drains, as far distant as may be practicable from the point at which the first-mentioned opening shall be situated, a pipe or shaft, vertically, to such a height and in such a manner as effectually to prevent any escape of foul air from such pipe or shaft into any building in the vicinity thereof, and in no case to a less height than 10 *feet.* (*b.*) In every case where the foregoing arrangement of the openings to the drains may be impracticable, there shall be substituted the arrangement hereinafter prescribed. One opening shall be obtained by carrying up from a point, as near as may be practicable to the trap, which, in pursuance of the by-law in that behalf, shall be provided between the main drain or other drain of the building and the sewer or other means of drainage with which such drain may lawfully communicate, a pipe or shaft, vertically, to such a height and in such a manner as effectually to prevent any escape of foul air from such pipe or shaft into any building in the vicinity thereof, and in no case to a less height than 10 *feet.* Such opening shall also in every case be situated on that side of the trap which is the nearer to the building. The second opening, being at a point in the drains as far distant as may be practicable from the point at which such last-mentioned pipe or shaft shall be carried up, shall be at or near the level of the surface of the ground adjoining such opening, and shall communicate with the drains by means of a suitable pipe or shaft. (ii.) He shall cause every opening provided in accordance with either of the arrangements hereinbefore specified to be furnished with a suitable grating or other suitable cover for the purpose of preventing any obstruction in or injury to any pipe or drain by the introduction of any substance through any such opening. He shall, in every case, cause such grating or cover to be so constructed and fitted as to secure the free passage of air through such grating or cover by means of a sufficient number of apertures, of which the aggregate extent shall be not less than the sectional area of the pipe or drain to which such grating or cover may be fitted. (iii.) Every pipe or shaft which may be used in connexion with either of the arrangements hereinbefore specified shall be of a sectional area not less than that of the drain with which such pipe or shaft may communicate, and not less in any case than the sectional area of a pipe or shaft of the diameter of 4 *inches.* (iv.) No bend or angle shall (except where unavoidable) be formed in any pipe or shaft used in connexion with either of the arrangements hereinbefore specified. (v.) Provided always, that for the purpose of either of the arrangements hereinbefore specified the soil-pipe of any watercloset, in every case where the situation, sectional area, height, and mode of construction of such soil-pipe shall be in accordance with the requirements applicable to the pipe or shaft to be carried-up from the drains, may be deemed to provide the necessary opening for ventilation which would otherwise be obtained by means of such last-mentioned pipe or shaft.

first, that the ventilating outlet shaft shall be between the trap and the building, so as to promote the fouling of the water in the trap; second, that the inlet for air shall be at or near the surface of the ground from which the outlet shaft rises; a provision which would preclude any advantage presented by a fall in the surface of the ground between the outlet and inlet.

Though it is proposed to protect the inlet aperture by a grating, there can be little doubt many persons will find in the gratings a convenient method of disposing of small articles, the possession of which has become inconvenient. In other ways the gratings will probably be abused, as, in certain districts, they will be regarded as substitutes for those public conveniences, which local authorities in England are so reluctant to supply.

According to the Model By-law No. 62, if a drain passes under any building it is to be laid in a direct line for the whole distance beneath the building; the practical difficulties in the way of complying with this provision appear to be entirely overlooked by its framers. Reverting to the drain mentioned above, which was diverted from the nearest sewer to another 400 feet distant, and laid for that length under the building, no one practically acquainted with the subject can suppose that drain was laid in a direct line. It was laid in the line of least resistance, that is, under voids, so as to avoid disturbing the foundations of piers; and it was diverted, where necessary, for junction with branch drains, of which there are several under the same building. What was desirable and practically unavoidable in this work re-appears in many other structures, especially in extensive factories and workshops; a practical man would qualify the provision by using the words "as far as practicable."

To the same want of familiarity with the actual execution of work is to be ascribed the Model By-law No. 66,* which prohibits any inlet in a drain within any building. Hydraulic lifts are usually so placed, and, frequently, at some distance from an outside wall; when the water is discharged into the sewer a drain has to be laid under the building, and the inlet must be within it. So of the discharge from other hydraulic apparatus, from steam engines and other manufacturing appliances, all of which must be fixed where they are required. So, also, in private houses, counting-houses, hotels and other buildings; lavatories are often required in bedrooms, and in subdivisions of counting-houses and shops; housemaid's closets and butler's pantries are also to be supplied; and their position cannot always be against outside walls, without an appropriation of space otherwise too valuable.

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* *Model By-law* 66.—A person who shall erect a new building shall not construct any drain of such building in such a manner as to allow any inlet to such drain (except such inlet as may be necessary from the apparatus of any watercloset) to be made within such building. He shall cause the soil-pipe from every watercloset in such building to be at least 4 *inches* in diameter, and to be fixed outside such building, and to be continued upwards without diminution of its diameter, and (except where unavoidable) without any bend or angle being formed in such soil-pipe to such a height and in such a position as to afford, by means of the open end of such soil-pipe, a safe outlet for sewer air. He shall so construct such soil-pipe that there shall not be any trap between such soil-pipe and the drains, or any trap (other than such as may necessarily form part of the apparatus of any watercloset) in any part of such soil-pipe. He shall also cause the waste-pipe from every bath, sink (not being a slop sink constructed or adapted to be used for receiving any solid or liquid filth), or lavatory, the overflow pipe from any cistern and from every safe under any bath or water-closet, and every pipe in such building for carrying off waste water to be taken through an external wall of such building, and to discharge in the open air over a channel leading to a trapped gully grating at least 18 *inches* distant. He shall, as regards the mode of construction of the waste-pipe from any slop-sink constructed or adapted to be used for receiving within such building any solid or liquid filth, comply in all respects with such of the provisions of this by-law as are applicable to the soil-pipe from a watercloset.

It may, indeed, be said that the waste-pipes may be carried along the inside of the walls around chimney-breasts, and between a ceiling and a floor, and so through the outside wall nearest to the outfall; but, to all intents and purposes, such a pipe is a drain, and one very liable to injury from frost, rats and otherwise, if made of lead. In the case of subdivided premises, like counting-houses and shops, it may not be practicable to lead the pipe to an outside wall without passing through premises occupied by a different tenant, who may reasonably object to, and possibly may be able to prevent, such an intrusion. So long as the drain-pipe, whatever the material, is impervious, so that neither water nor gas can escape, the different parties interested should be at liberty to act according to their discretion; otherwise, they are likely to forego various appliances, with a result unfavourable to cleanliness and health, and to the economy of labour. Lead pipes are used in the distribution of illuminating gas and prevent its escape, and are equally retentive of sewer gas.

To require all drain-pipes, not being soil-pipes nor waste-pipes from sinks used for receiving filth, to be discharged in the open air over a channel leading to a trapped gully-grating, at least 18 inches distant, is to revert to a practice formerly universal, but abandoned many years ago, because so fraught with annoyance and danger. It was found that in severe weather the water in the trap, as well as that in the channel, was frozen; and with every additional discharge of water the area of ice was extended, and the public seriously inconvenienced by the slippery state of the pavement. Even in open weather, the passage of water from the pipe to the grating is liable to be obstructed and diverted, so as to pass over a considerable area of the side-walk of the street; and the gratings, with deposits of soap and other impurities, are very objectionable in appearance, and sometimes slippery as well as offensive nasally. To require all drain-pipes of every kind to be fixed outside a building exposes them to being frozen-up and rendered useless so long as the frost lasts. I have seen, in one of the leading thoroughfares in Liverpool, the soil-pipes from a nest of water-closets in a block of offices or counting-houses coated with foul-looking discoloured ice and icicles, and this for several weeks during which the frost continued. It does not appear desirable to multiply examples of this kind, nor to subject the occupiers of similar premises to the privation of lavatories and other appliances promotive of health and cleanliness.

The Model By-law, No. 67,* requires that one side of every water-closet shall be an external wall, a provision which cannot always be complied-with. In railway stations, for example, the closets are sometimes placed against the wall of the platform, and are ventilated from the covered court in which passengers enter and leave their trains, and closets in such positions are not usually offensive. Sometimes the closets are against walls abutting on other buildings, but are approached through well-lighted and ventilated courts. In other buildings, such as blocks of offices, or counting-houses, it has been found desirable to place those conveniences in well-lighted and ventilated apartments, either in the roof or in the basement, away from external walls, but adjacent to the staircases or corridors, also well-lighted and ventilated. To place them on the intermediate floors would involve the loss of very valuable space, and an absence of privacy, with less efficient ventilation. In commercial premises light is too

* *Model By-law* 67.—Every person who shall construct a watercloset or earthcloset in a building shall construct such watercloset or earthcloset in such a position that one of its sides at the least shall be an external wall.

valuable on the more accessible floors for appropriation to water-closets. If closets are well lighted and well ventilated, all reasonable sanitary requirements are satisfied.

A careful examination of the Model By-laws leads to the inference that they result from a compromise between conflicting advisers; thus only can their inconsistencies and discrepancies be explained. Probably the original draft was prepared by some one practically acquainted with the conditions under which buildings are constructed. Subsequently it was submitted to another, fully alive to the evils resulting from the careless or wilful neglect of needful precautions, but totally indifferent to the necessities by which the practical applications of science are conditioned; and consequently unable to appreciate the importance of so adapting science to every day life, as to prevent it from creating evils greater than those it should obviate. I have no doubt the injudicious and excessive use of traps, for example, will be productive of great danger to health,—dangers quite as great as those which I suppose the framers of the By-laws wished to prevent. Considering that public and official attention has been so much engrossed by the unhealthy condition of large towns during the last forty years, it is surprizing sanitary science should still be so very empirical; that so very little has been done to collect and systematize the available facts, so as to determine the principles which should be the foundation of sanitary law. This is doubtless to be ascribed to the undue influence which has been conceded to members of the medical profession. It was not unnatural for the public to suppose that professors of the healing art would probably be the best advisers on the means of preventing disease. No doubt medical men are competent to advise on the sources from which diseases spring, but medical science is still admittedly unable to explain phenomena of importance; and the knowledge of the sources of disease does not confer ability to devize the means of protection, where the application of those means is complicated by structural and other difficulties. I am reluctantly compelled, from the results of forty years' empiricism, to ascribe the deplorable state of sanitary science and the unsatisfactory diminution of the rate of mortality, notwithstanding enormous expenditure, to the undue influence accorded to members of the medical profession and other theorists. As an important step towards recovering the clue through the difficulties which beset sanitary improvement, I suggest the true position of architects and engineers should be more distinctly recognized; and that they be required to assume their legitimate responsibilities.

Plumbers and Drainers.—It is difficult to over-rate the importance of having all plumbing and draining executed substantially and well; but under existing arrangements the difficulty of securing good work and material is almost, if not quite, insurmountable. No doubt there are firms who adopt every precaution, and employ none but trustworthy men with good and sound material; but they are in small ratio to those who act otherwise. In one or more of the United States, I understand, plumbers are licensed, and none others allowed to undertake work. In Liverpool none but "authorized" master-plumbers are allowed to execute any work connected with the supply of water; and the size and weight of the pipes are prescribed; as regards the fittings, none may be used which have not been tested and stamped by a staff appointed for the purpose. I think the supervizion of pipes and fittings is to some extent too minute, but the principle of licensing master-tradesmen seems excellent and advisable for all plumbing and all drainage.

In addition, it appears desirable that artizans should also be licensed, especially the

artizan-plumber, and the foreman, ganger, overlooker, or leading hand in charge of drainage. If offenders were liable not only to lose their license through defective work, but also to indictment for misdemeanour, the public would have some security for the proper execution of ordinary plumbing and drainage; at present they have none.

Modes of Construction.—Passing to those provisions which affect the stability of buildings, it seems important again to revert to what has been termed the first principle in structural legislation, namely, to avoid the confusion of essentials with matters only desirable, however desirable they may be. Another principle scarcely less important, and almost a corollary from the first, is to avoid putting upon the manufacture of dwellings and other erections any avoidable restrictions—that is, the trade should be left as free as possible.

If these views are correct, it follows that the provisions for regulating the trade should not enter into such details as the ingredients of mortar and concrete. It would be just as reasonable to specify the kind of timber, or the composition of the iron and other metals. So completely has this been recognized by the framers of the Model By-laws, and by those who framed the Metropolitan Building Act, that they have omitted all reference to the quality and strength of the timber used in floors and roofs, though timber is essential to the stability of most buildings. Yet neither code requires that the timber be even sound and good, nor of sufficient strength, nor put together in a workmanlike manner; there seems to be the like laxity with respect to the use of iron, for the provision in the Metropolitan Act as to buildings to which the rules are inapplicable appears to apply to walls only, according to the rules in Schedule A.

In the proposed amendments of the Liverpool Building Act,* it is provided that the ingredients of concrete as to quality, proportion, mixing and laying, shall be to the satisfaction of the building surveyor; and that the cast or malleable iron shall be of good quality, without flaw or defect, and shall be of sufficient strength; the storey-posts and beams firmly and truly laid on a sufficient foundation or bearing, and securely fixed in a workmanlike manner, and the whole work done to the satisfaction of the building surveyor, who is an officer appointed by the City Council, and with his assistants, is required to devote the whole of his time to the duties of his office.

The language for those provisions is clearly borrowed from the specification of a building contract. I do not know that their introduction into a legislative enactment is objectionable, except that for the building surveyor to be sole judge on matters open to difference of opinion among competent persons is highly improper, especially as his interference may embarrass the parties to a contract. If such enactment be adopted it may happen that the most talented and experienced members of the profession, who have passed the Presidential Chair of the Institute of Architects, may be required to alter a building contract in compliance with the dictum of a building surveyor of far inferior qualification. In such a town as Liverpool it may be anticipated the surveyor will be too discreet to place himself in such a position; but a statute which governs the whole kingdom, may vest such a power in mere youths, as rash and imperious as they are deficient in experience and discretion.

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* This Bill has been withdrawn, and the Bill deposited is entitled *Liverpool Improvement;* which is an omnibus bill for amending various local Acts, including the Building, Fire Prevention, and Sanitary Acts, the purchase of land, superannuation of officers, and other matters.—J. B.

Even in building contracts similar absolute authority as to matters in dispute between the parties, when vested in the architect, has been open to objection; and in deference to the wishes of master builders, there is now usually an appeal. It is, however, optional with a tradesman whether he enters into a contract; if he distrusts the architect he may abstain from offering a tender, but under Acts of Parliament the public have not any such option; if they build they cannot escape the autocracy. Clearly there should be an appeal in all similar cases,—no individual should be clothed with such authority; it is not every man who can be trusted with such power at any time, nor every man who can be trusted at all times. Besides such fetters impede the advance of a progressive art; no improvement can be introduced into any district unless it is approved by an officer, who may owe his position to favour, and be wholly incompetent to form a correct opinion. Skill and experience should not be thus wire-drawn, but should have as much scope and freedom as are consistent with the public weal, because such scope and freedom conduce to the public weal.

Doubtless there must be some authority who shall decide differences of opinion as to alleged infringements of, or non-compliance with, the law; at present such differences are decided in a police court. Obviously that is a very unsatisfactory tribunal for subjects scientific and practical, unless the bench have the assistance of experts as assessors, sitting with them, and possessing, *pro hâc vice*, co-ordinate powers. Precedents for such a combination may be found in the investigations into the loss of ships, and in some causes before the County Courts.

It seems preferable, however, to appoint a special tribunal of skilled and responsible experts, consisting of a limited number for each district into which the country may be divided for the purpose, with a superior court* sitting in London, by whom appeals should be taken from the local courts, and principles laid down for the guidance of subordinate tribunals. Each court to have the assistance of a lawyer, as clerk or as assessor, and the extent of its jurisdiction determined by the population and amount of business, but to include a number of urban and rural districts. To these tribunals might be referred all questions as to materials old and new, workmanship, party-ownership, ruinous structures, ventilation, and other sanitary and structural questions; and, possibly cases of ancient light and air with other easements—the object being to secure a cheap and equitable settlement of all matters relating to building operations, in which the public are entitled to have an interest.

Classification.—It is important to have buildings of every kind distinctly classified, so that requirements may be varied according to the purpose of every erection; it is also important to have an interpretation clause which shall define the sense in which various terms are used in enactments relating to building.

Neither the Metropolitan Building Act nor the Model By-laws, contain any definition of the term building. The definition of the term party-wall appears to present difficulties hitherto without solution. The definition in the Model By-laws as to the first clause is an extension of the definition in the Metropolitan Act, and it may with advantage be subjected to examination; it is as follows (see Model By-law, No. 1):—

"(*a.*) A wall forming part of a building, and being used, or constructed to be used, in

* See a Decree of the French Government, 6th January, 1882, an extract from which is printed in the PROCEEDINGS, 1881-82, p. 219.

any part of the height or length of such wall for the separation of adjoining buildings, belonging to different owners, or occupied, or constructed, or adapted to be occupied by different persons; or,

"(*b.*) A wall forming part of a building, and standing, in any part of the length of such wall, to a greater extent than the projection of the footings on one side on grounds of different owners."

Confining criticism to the first clause, it will be seen that a definition of the term building is absolutely necessary. For example, a building, as was the Westminster Palace Hotel immediately after its completion, may be temporarily divided into two occupations as distinct as the India Board and the Hotel,—that is, adapted for occupation by different persons; and the division wall, though only for a temporary purpose, would have to be built as a party-wall; on the other hand, when the double occupation ceased, the necessity for a party-wall would no longer exist. Whilst the double occupation continued would the structure be two buildings? And when that occupation terminated, would the two buildings become one? Let it not be said this is mere casuistry, for oftentimes such questions become important. I am aware of a case in which a wealthy man wished to throw two houses into one, but was compelled to maintain the party-wall, and to make all his communications through it as in a party-wall.

Again, under the influence of local changes, large dwellings become converted into separate tenements, the ground-floor sitting rooms becoming a lock-up shop, the entrance and stairs being used exclusively by the inmates of the remainder of the house, which is adapted for occupation by different persons on each flat, if not in each room: does not such adaptation of shop and apartments require the conversion of the brick or lath-and-plaster partitions into party-walls, and the floors into party-arches or fire-proof floors?

Clause 27* of the Metropolitan Building Act, without defining the word building, contains provisions as to the separation of buildings and the limitation of areas; but I suspect the clause is pretty much of a dead letter as respects the case proposed above, or the division of a large shop into two or more. The clause tacitly concedes exemption in buildings which do not exceed 3,600 feet, or 400 yards in area. Beyond the limits of the metropolis I apprehend party-arches and fire-proof floors, as party-structures, are almost unknown.

The fourth section of the same clause limits the size of warehouses and factories to 216,000 feet cube. Many cotton, woollen, flour and rice mills greatly exceed that size, and weaving sheds are measured by the acre. Under the Liverpool Fire Prevention Acts,

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* XXVII.—The following rules shall be observed as to the separation of buildings and limitation of their areas:—1. Every building shall be separated by external or party walls from any adjoining building; 2. Separate sets of chambers or rooms tenanted by different persons shall, if contained in a building exceeding 3,600 square feet in area, be deemed to be separate buildings, and be divided accordingly, so far as they adjoin vertically by party walls, and so far as they adjoin horizontally by party arches or fire-proof floors; 3. If any building in one occupation is divided into two or more tenements, each having a separate entrance and staircase, or a separate entrance from without, every such tenement shall be deemed to be a separate building for the purposes of this Act; 4. Every warehouse, or other building used either wholly or in part for the purposes of trade or manufacture, containing more than 216,000 cubic feet, shall be divided by party walls in such manner that the contents of each division thereof shall not exceed the above-mentioned number of cubic feet.

warehouses may contain 300,000 feet cube, and in that city there is not any limitation to the size of other buildings.

I am not aware of any other town in which such stringent precautions against the spread of fire are required in warehouses as in Liverpool. In what are known as registered and certified warehouses, the doors and window-shutters may be of wood, or of wood plated with iron, to the reasonable satisfaction of the surveyor of buildings, and to such rules as the Fire Prevention Committee of the Town Council may from time to time think proper; or they (the doors and shutters) must be altogether of iron of sufficient strength, closely fitted to the apertures, and of plates not less than a quarter of an inch thick; when larger than 6 square feet, the door or shutter shall have rails and stiles of wrought iron, 3 inches wide and a quarter of an inch thick, riveted on the plate, or otherwise strengthened, to the approbation of the surveyor and to the rules and regulations of the Fire Prevention Committee: the requirements vary with the width of the street upon which the doors and windows open. Openings in party-walls, for intercommunication, must be protected with iron doors on each side of the wall.

In what are known as fire-proof warehouses, there may not be any woodwork: the floors must be constructed of brick arches, not less than 9 inches thick, or with flags and stones, with sufficient iron girders to the satisfaction of the Fire Prevention Committee, finished with flag, concrete, or brickwork; the roofs must have iron principals and common rafters, with the slates fastened without wood.

These Acts were passed nearly forty years ago, and, from the wording, it is illegal to adopt any of the modern improvements, such as iron and concrete floors, concrete arching, solid timber blocks, or any other of the so-called fire-proof floorings; nor is it allowable for the doors and shutters to be of concrete, indurated fibrous plaster, or other incombustible material, except iron. They thus furnish another illustration of the marked difference which should exist between a contract-specification and an Act of Parliament. The frequent amendment of Building Acts in London and elsewhere may be ascribed, in part at least, to similar erroneous conception as to the tentative character which should be given to legal enactments for regulating buildings, and their sanitary arrangements. It is not obvious why greater precautions against fire should be adopted in Liverpool than are found necessary in the warehousing districts of the metropolis and other places, and why, for this purpose, also, legislation should not be uniform.

In addition to the regulations cited, the Liverpool Fire Prevention Acts prohibit the carrying-on of certain hazardous trades within 20 yards of any warehouse, unless the chimney be carried-up to the height of 5 feet above the ridge of every warehouse within that distance; and all warehouses must have parapet walls; but on no other buildings are such walls compulsory: another example of anomalous inconsistency with the Metropolitan Building Act and the Model By-laws. If parapet walls have not been found necessary in other large towns, they may surely be dispensed-with in the cities and towns comprized in the Metropolitan district, as well as in smaller places, though doubtless they are very desirable in special cases.

Walls.—The rules for determining the thickness of brick walls, as given in the Metropolitan Building Act and the Model By-laws, appear to me very complicated, and capable of being expressed with greater simplicity. The obvious principle is, that, other things being equal, the thickness of walls should be in proportion to the height; but warehouses being exposed to

much rougher usage than dwelling-houses, it is necessary their walls be of greater strength; and many public buildings are exposed to contingencies different from those incident to other structures.

It is not apparent why party-walls should be as thick as external walls. The latter are weakened by openings for doors and windows; they are not usually tied into the building, nor strutted by the timbers of floors and roofs, and they are exposed to all the changes of atmospheric temperature, to rain and to wind. Party-walls, on the other hand, are considerably strengthened by the timbers of floors and roofs, by cross-walls and chimney-breasts, and, being under cover, are protected from storms, wet, and fluctuations of temperature. Therefore, the thickness of party-walls may be wisely reduced by one-sixth from that of external walls, but in no case should they be less than 8½ inches. Further, it is very desirable not to allow the timbers of floors and roofs to be inserted in external and party-walls, which should be carried upon the set-offs, where the thickness of walls is reduced, or upon corbel-courses, or detached corbels, as circumstances may render expedient. When the ends of timbers are bedded in walls, there is usually great difficulty in having the work properly executed; there is consequently a band of inferior work, which weakens the walls and harbours vermin. On the other hand, if the work is sound and good, there is a tendency to produce rot in the timber.

In Liverpool, when adjoining owners are unable to agree upon a party-wall, each is allowed to build what is termed a separate side wall, or a separate end wall, which is not so thick as a party-wall; party-walls in Liverpool being thinner than external walls. This power of erecting separate walls by each owner, exclusively on his own ground, is frequently very convenient in preventing disputes. Such walls might be two-thirds of the thickness of parti-walls, but not less than 8½ inches; two such walls would, therefore, give a substance one-third thicker than a party-wall.

That cross-walls should be two-thirds of the thickness of external walls, as in the Metropolitan Building Act and the Model By-laws, appears to me unobjectionable.

With regard to the thickness of walls, as well as to other provisions, it is important that the necessary amount of material and labour be not exceeded as a minimum; anything more tends to increase unnecessarily the cost of production, and consequently leads to retrenchment in the outlay, or to increased rent. Thus architects are compelled to adopt a treatment less artistic than the work is susceptible of, and tenants are deprived of conveniences which, directly or indirectly, conduce to greater healthiness. It must not be forgotten that, hitherto, it has not been possible to provide suitable dwellings for families, at rents ranging from one shilling to two shillings per week; and until this great and vital problem has been solved, there should be the utmost caution in requiring provisions which, however desirable, are not absolutely essential. There are thousands of unskilled labourers, amongst urban populations, whose average weekly earnings do not exceed twelve or fourteen shillings; there are multitudes of others whose income is much less; and many others without any fixed income at all, being wholly dependent on what they can beg, pick up, or steal. In a survey of a densely-peopled district in Liverpool, taken many years ago, it appeared that several families had not more than five shillings weekly; and I think this condition still prevails extensively. Sanitarian theorists can afford to set such difficulties at nought; but to those really desirous of extending sanitary improvement to the utmost such difficulties cause grave and anxious reflection.

Some may, perhaps, be disposed to think the writer has given too much space to sanitary problems; but their solution is one of the great purposes for legislation in connexion with buildings, the *trinodis necessitas* being stability, security from fire, and healthiness.

Ruinous Structures.—The powers over dangerous structures conferred upon local authorities under the Metropolitan Building Act are very similar to those given under the Towns' Improvement Clauses Act, 1847. The local authority is empowered to have a structure surveyed, and it is lawful for the justices, before whom an information therein may be brought, to dismiss the information, or to order the adoption of certain specified precautions. Though this power has been found sufficient in the metropolis for a lengthened period, the authorities of the city of Liverpool have actually desired to compel the justices to make their order for taking down the structure on the *ex parte* information of their own surveyor, without any discretion to the justices, and without allowing the owner to adduce evidence that the surveyor is in error. This is another illustration of the dangerous tendency in authority to become autocratic, and to compel all within its domain to absolute submission.

Projections.—The rules for limiting the projection of architectural and other features prescribed under clause XXVI., sects. 2 and 5 of the Metropolitan Building Act appear to me too stringent, whilst those contemplated by the Liverpool authorities are extremely complicated, as well as highly objectionable otherwise. Whilst, artistically, the projections should be influenced by the height of the building, as well as by the width of the street, the latter is the only condition which affects the public convenience. The rules I suggest, therefore, are :—

1. Strings, cornices, pilasters, &c., not less than 12 feet above the pavement, may project 1-30th of the width opposite the building in any street.
2. Oriel windows, balconies, verandahs, &c., may project 1-20th of the same width.
3. At any height less than 12 feet above the pavement the projection shall not exceed 1-60th of the same width.

I am aware that in London and other places more latitude is given to shop-fronts; and in Liverpool door-casings, as well as shop-fronts, are allowed to project beyond the line of street. It seems to me this privilege is very objectionable, as it contracts the roadway where there is the greatest traffic; besides, shops tend to collect groups of gazers, who are themselves extremely inconvenient.

Exempted Buildings.—Both the Model By-laws and the Metropolitan Building Act, as well as other enactments, contain a list of buildings to which their respective regulations do not apply, which appears to be a tacit admission that the framers do not consider their respective codes to be essential for the stability of those structures, for their security from fire and for their healthiness. The *trinodis necessitas* for all other structures ought to be imperative upon the exempted buildings also. The relaxation is the more remarkable as among buildings so privileged have been found conspicuous examples of unhealthiness and insecurity from fire, clearly showing that in those cases some external authority was desirable. The omission of necessary precautions is just as dangerous to the public in the buildings privileged to be exempt as in others. So long as regulations merely prescribe what is necessary, exemptions should not be granted; there is less necessity for enforcing what is only desirable, as on that there may be differences of opinion, and all should have freedom of choice.

Plans.—One of the strongest instances of the bureaucratic spirit which has inspired the

Model By-laws is to be found in the requisitions for plans and other drawings for intended streets and buildings. It is very much to be regretted the extremely moderate suggestions for their amendment which emanated from the Council of the Royal Institute of British Architects, were not accepted by the Local Government Board. It is lamentable to see any department descending to such petty inquisitorial details—a proceeding more resembling the practices attributed to the officials of some minor foreign States than the reasonable requirements of a constitutional government. Nothing more conclusively shows how much some influential persons have lost discretion under an irrational panic and its offspring, an equally irrational mania. Every local authority ought to possess a plan of its district, such as is described in Clause XIII. of the Towns' Improvement Clauses Act, 1847, for which a scale of 60 inches to a mile is specified. That scale is ample for any plan of proposed streets which is to be deposited with the authority, for comparison with the official map, and with the 5 feet ordnance in sheets, where it exists. Usually the section of the street should be drawn to a vertical scale considerably larger than the horizontal scale. As for requiring the plan to show the size and number of the intended lots; the size, height, class and nature of the buildings; and the height of the division and fence walls, all that is useless and, if furnished, must be to a large extent hypothetical and imaginary. The person who framed those requisitions can have had but little practical experience, and cannot have given even casual attention to the subject, or he would be aware all those matters are affected by a variety of circumstances, including whim and caprice; that frequently the nature of the whole buildings, including the division and fence walls, is radically changed before the building sites are covered—sometimes before the first brick is laid. The requisition as to division and fence walls is perfectly puerile, as it cannot at all affect the authorities, who have no control over them; it is, however, vexatious and irritating, and springs from that intermeddling spirit of which I regret to observe too many indications throughout the Model By-laws.

The Model By-law No. 92,* is still more offensive. Many persons about to build object strongly to having the interior details of their domestic or business arrangements exposed to the prying curiosity of gossips, or of rivals in trade. It may be desirable to require a block plan, to a

* *Model By-law* 92.—Every person who shall intend to erect a building shall give to the Sanitary Authority notice in writing of such intention, which shall be delivered or sent to their clerk at his or their office, or to their surveyor at his or their office, and shall at the same time deliver or send, or cause to be delivered or sent to their clerk at his or their office, or to their surveyor at his or their office complete plans and sections of every floor of such intended building, which shall be drawn to a scale of not less than 1 *inch* to every 8 *feet*, and shall show the position, form, and dimensions of the several parts of such building, and of every watercloset, earthcloset, privy, ashpit, cesspool, well, and all other appurtenances. Such person shall at the same time deliver or send, or cause to be delivered or sent to the clerk to the Sanitary Authority at his or their office, or to their surveyor at his or their office, a description in writing of the materials of which it is intended that such building shall be constructed, and of the intended mode of drainage and means of water supply. Such person shall at the same time deliver or send, or cause to be delivered or sent to the clerk to the Sanitary Authority at his or their office, or to their surveyor at his or their office, a block plan of such building which shall be drawn to a scale of not less than 1 *inch* to every 44 *feet*, and shall show the position of the buildings and appurtenances of the properties immediately adjoining, the width and level of the street in front, and of the street, if any, at the rear of such building, the level of the lowest floor of such building, and of any yard or ground belonging thereto. Such person shall likewise show on such plan the intended lines of drainage of such building, and the intended size, depth, and inclination of each drain; and the details of the arrangement proposed to be adopted for the ventilation of the drains.

scale of, say, 10 feet to the inch, for the purpose of showing the drainage. As the By-laws give specific directions on the mode of drainage, its ventilation, the position of water-closets, earth-closets, privies, sinks of all kinds and lavatories, with that of their several drainage pipes, the thickness of the walls, the height, area and mode of lighting and ventilating apartments, other plans are wholly unnecessary. If the person building does not comply with the By-laws he takes the consequences; and no deposit of drawings and specification will render the By-laws more binding. Indeed, it has been found that people, who contemplate evasion, are very careful to comply with all preliminaries, and thus sometimes escape the supervision needed by them of all men.

The plan showing the position of the buildings and appurtenances of the properties immediately adjoining the proposed building, and the level and width of the streets, front and back, ought to be wholly unnecessary, if the local authority has a plan of its district brought down to date. In many cases it is impossible to survey the adjoining buildings and appurtenances by those not legally empowered to do so; people naturally object to have their privacy intruded upon; and are apt to regard the visits of unauthorized persons as impertinent, and to be resented. The local surveyor being empowered to enter premises in the district ought to record upon the district map all changes as they are made, so as to be able to supply to the Board, or to ratepayers, information of the kind referred-to.

According to the By-laws of the Metropolitan Board it is not necessary to deliver any drawings. In the case of public buildings, plans and sections sufficiently in detail to show the construction must be *deposited* with the district surveyor, but a temporary deposit is very different from a permanent deliverance; and public buildings are frequently of such a nature as to render full information desirable. In respect to other buildings drawings are not required, even on deposit; but the district surveyor may require the *production* of plans and sections for inspection, a provision which is unobjectionable.*

If for a district like the metropolis it has not been found necessary to demand "complete plans and sections of every floor" of an intended building, such a requisition must be unnecessary elsewhere; and it is very unwise for authorities to excite ill-feeling by irksome, inquisitorial and unreasonable demands.

Under the Metropolitan Building Act the district surveyor must have notice two days before any building operation is commenced; but in some urban districts a notice is required fourteen days beforehand; in Liverpool one day's notice is considered sufficient; in other places a notice of three days. Probably two days' notice would be found most convenient.

Surveyors of Buildings.—Another important subject, which should not be overlooked, is the appointment of the surveyors, who are to assist the local authority in enforcing the provisions

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* 5.—*Deposit of Plans and Sections.* On Notice being given to a District Surveyor of the intended erection, re-erection, alteration of, or addition to a Public Building, or a Building to which Section 56 of the Metropolitan Building Act, 1855, applies, it shall be the duty of the person giving such Notice to deposit Plans and Sections of such erection, re-erection, alteration, or addition, with the District Surveyor. Such Plans and Sections shall be of sufficient detail to show the construction. On Notice being given to the District Surveyor of the intended erection or alteration of or addition to any House, Building, or other Erection, other than a Public Building, the District Surveyor may, if he think fit so to do, by notice in writing, require the person giving such notice to produce a Plan or Plans and Sections of any such House, Building, or other Erection, or of the intended alterations or additions thereto, for his inspection.

of a General Building Act. There are no doubt men of the highest character filling appointments under local authorities, but it is open to consideration whether as a class they hold a position, adequate, in all cases, to resist the influences which can be brought to bear upon them ; or, to give them sufficient authority on subjects of constructive novelty. I am acquainted with a district in which the attention of the board was drawn to the fact that their by-laws were constantly infringed. At first the surveyor asserted that they were enforced ; but subsequently, after a sub-committee had examined several buildings and found numerous infringements as alleged, the surveyor reported that the by-laws never had been enforced and could not be enforced. It is now more than seven years since this incident occurred, and both the by-laws and the surveyor are unchanged. There is reason to believe there are other districts in which similar laxity exists; and if the Local Goverment Board were to institute inquiry, the information elicited upon this, and other departments of local management, would, no doubt, be instructive. There is much that is admirable in the principle of local self-government, but, to be successful, it is essential for the constituency to be actively interested in the election of their representatives, and in the manner in which they fulfil the trust confided to them. But it is notorious that in many places the management of local affairs is by cliques, who select the representatives for almost any other qualification than the knowledge and ability required in the office. Party politics, personal emolument and trade interests, together with the desire to keep down the rates, are too often the potent factors; whilst ignorance, the fear of giving offence and indifference, are influential allies. There are cogent reasons against the management of local affairs by a department of the National Government exclusively; but, I think, a combination of the imperial and local systems can be adjusted so as to be highly beneficial. It would be a judicious blending of local with national self-government.

Reverting to the proper discharge of their duties by local authorities, it is clear that, for a board to adopt a carefully prepared system of by-laws and to neglect to enforce those laws, is very deceptive conduct, and fraught with the gravest peril to the public, especially to the tenants, purchasers and mortgagees of property, who have relied upon the by-laws having been always impartially enforced, and may be betrayed into liabilities wholly unexpected.

Reverting to the appointment of building surveyors, my preference is in favour of the system which has prevailed in the Metropolis for such a very long period, and is apparently justified by results. Whilst in very populous districts more than one surveyor would be required, there are other districts in which there is so little building that a number might be grouped together. In any case, the gentlemen selected should hold certificates of competency from the Royal Institute of British Architects; and they might be appointed by the Local Government Board from candidates nominated by the local authorities, whom they are to assist.

Conclusion.—The enactments which have been reviewed are intended to confer upon the local authority great powers for the public good; but there seems a great lack of what lawyers term reciprocal covenants, and it may be excusable to quote from a Delectus, *Quis custodiet custodes ?* It is, I conceive, absolutely necessary, in the interest of the public health and on other grounds, to provide a simple and inexpensive method whereby peccant authorities may be brought to repentance, by an inexpensive method, I mean one by which the individual on whose suggestion proceedings are instituted shall be relieved from pecuniary liability, the costs of inquiry being defrayed by the erring members of the Board, by the ratepayers of the

district, or out of the county rate, at the discretion of the judge before whom the indictment is laid. The prime mover, in all probability, incurs great loss of time and considerable odium by calling effective attention to the *lâches* of the Board; whether he should recover his own expenses out of pocket may also be left to judicial discretion.

However perfect structural and sanitary enactments may be, it is manifest that they are utterly worthless if not enforced with uniformity, impartiality and intelligence. In the case referred-to above, the great majority of the Local Board, as well as their surveyor, were guilty of very gross misconduct, and ought to have been severely punished; but they escaped, because, practically, there was not any authority to censure them.

I have now completed, to the best of my ability, the task I have been requested to undertake. I fully appreciate the honourable distinction conferred by that request, and the grave responsibility incurred by acceding to it. Happily this is only a tentative essay to form the basis of further inquiry and discussion: I have sought to make it, for that purpose, as complete as reasonable limits would permit; doubtless there are various topics, especially details, to which it has not been possible even to allude. I trust the defects will be largely supplied by discussion; but the importance of securing a uniform system for regulating the structural and sanitary arrangements of buildings is so great, it may perhaps excuse the rashness of my venture. If a uniform system is essential, the first obvious step is to determine the principles on which that system should be framed, and to those I have sought to direct attention.

P. GORDON SMITH, *Fellow*.—Sir, Mr. Boult has raised a great many important questions, with some of which I entirely agree, while I dissent from many others. There are several points also wherein I believe he has fallen into error, no doubt through misapprehension; in fact, I am sure they have arisen from misapprehension, both in reading the Model By-laws themselves, and in possibly not being fully acquainted with those parts of the Public Health Act which relate to the By-laws in question. I would just refer to one or two points that occur to me. One was about the absence of any definition of the term "building" in the Model By-laws. Those By-laws are intended to apply exclusively to new buildings, and a sufficient definition of the term "new buildings" is contained in the Public Health Act itself, and therefore there is no occasion to have the definition in the Model By-laws. Any local authority, if they choose, can attach as much appendix as they please, and can append any number of clauses of the Public Health Act to their series of by-laws, and in that way could be got the definition which Mr. Boult would like included in the By-laws themselves. I would refer to another point. The question of damp-courses is one in which no doubt everybody is interested. The arrangement of the damp-course must obviously be such that the damp-course itself shall be above the ground where it is in contact with the wall. This may be rather difficult in some places, but it is essential that it should be in that position, and consequently, if the damp-course has to be below the general ground-level, some sort of area must be formed to keep the ground away from the wall above the damp-course. With respect to some other of Mr. Boult's remarks, he seems to have overlooked the fact that these By-laws are intended to apply to new buildings yet to be erected. Consequently, a great many of the short-comings he refers-to could be met, and ought to be met, in the arrangement of any new

building. Architects are quite able to meet difficulties, and in fact, it is one of the functions of architects to get over difficulties; and where a new building has to be designed, it ought to be designed in such a way that all the essentials for health, stability, and prevention of fire, can be thoroughly met. Such a requirement, for instance, that a water-closet shall be so arranged that it may have a window in and be against an external wall, I am prepared to maintain is an essential. I do not think a skylight in a water-closet is a proper arrangement for ventilation, and it would in my opinion be a great defect if, in a model series of by-laws, it were regarded as sufficient to permit a water-closet to be constructed in a habitable building so that it could not have a window. I do not refer to water-closets in railway stations; there they may be constructed as Mr. Boult describes, but in new buildings intended for habitation I think every water-closet ought to have a window in an external wall.

LACY W. RIDGE, *Fellow.*—It happened the other day, Sir, to be my luck to be the first victim of a new Local Board; I was informed by a builder that the new Board wanted copies of all my drawings of a certain work. I told the builder, who fell very thoroughly into the scheme, to point out that it would be quite sufficient if a block plan showing the drainage were sent for the use of the Local Board, and that the drawings which he had were left with the surveyor for a day or two in order that he might look over them and see the character of the building that we were going to put up; that they would always be on the works for inspection, and that there was no reason why the surveyor should be put in possession of a lot of drawings to be hidden in a pigeon-hole and not used again. This argument appeared to be so well put by the builder that it was taken-up by the members of the Local Board, and we were quite successful in carrying our point; so that for the future almost exactly the scheme suggested by Mr. Boult will be that adopted by the Board. I think we should struggle, not only against unnecessary enactments, but against anything unnecessary which is likely to increase the cost of the building, whether that cost is to go to the builder or to be paid to the architect for unnecessary work in his office. I appeal to the Chairman with a certain amount of special feeling when I instance two Ecclesiastical bodies, one of which is quite content to see your drawings, and after due examination and severe criticism to approve and stamp them and send them back to you for use, to be produced when the architect attends; but the other Ecclesiastical body requires copies of the drawings and affidavits, and forms exceedingly elaborate in their nature, which are sent to the office, kept there for a few months, and are eventually consigned to a place of safety among the vaulting of the local cathedral, to be never looked-at any more. I think the principle of the body with which Mr. Christian is associated much more correct than the more ancient but less practical system which is to be found in Dean's Yard.

THE CHAIRMAN.—With reference to damp-proof courses: I have paid much attention to this subject, and think I may claim to know something about it. Damp-proof courses, like all other matters of construction, require intelligence in their use, and you ought not to be confined too strictly as to where they are to be laid. The course ought no doubt to be below the timbers, wherever they may be. I have found in practice that the best plan, when you have a basement storey, is to lay two damp-proof courses: one at the bottom to prevent the capillary attraction from the earth, and another at the level of the ground to shut-off the damp which may be supposed to run in laterally from the earth; but the great point is the connection between the two. I have had one or two remarkable pieces of experience in that

matter. Some years ago I had to rebuild a block of offices for the Ecclesiastical Commissioners, next Scotland Yard, and had to go twenty-five feet down below the surface of the street to get anything reliable as a foundation. The soil we had to go through was nothing better than Thames slush, and the water came close to the walls in the lower part. I designed my walls to be built with a hollow of 2 inches (14 inches outside and 9 inches inside, all built in cement). While the work was in progress it occurred to me that it would be worth while to fill this cavity with asphalte. I had already laid a horizontal course of it at the bottom; so I then filled the cavity up to the ground level with boiling asphalte, and afterwards laid an upper asphalte course over the outer thickness of the wall at the ground level. The first proof that I had of the value of the system was that the Chief of the Mapping Department, who had carried-on his work for years before in the old basement storey, and always suffered from rheumatism, told me that after two years' experience of work in the new offices he was completely cured. I had fortunately made the rooms fire-proof; and after some years' further experience they have proved to be so thoroughly dry that all the files of papers (between 60,000 and 70,000) belonging to the Office have been placed there, and in none of those files has there been found a particle of damp. A better illustration of the value of the vertical damp-course, and of the damp-course system generally, you could not possibly have. Let me add that in the neighbourhood of London the speculating builders frequently put what they call "dry areas." Now, in my opinion, they might be better named "damp collectors," and they are probably quite as costly as a really efficient vertical damp-proof barrier would be. They put a small cavity outside the wall, and a 4½ inch brick, taking no account of the water that is coming to it. It would cost them considerably less money to make this small cavity and fill it with asphalte. In a house I had to build I adopted the same plan, and there are not dryer walls in any basement in London, owing to the vertical damp-proof courses. I have often been asked—how do you bond across this cavity? I have proved by practice it is not necessary to bond at all. The asphalte has such extraordinary tenacity for brick that it holds to it, and becomes a perfectly solid body. I have reason to believe in a damp-proof course in spite of some observations of Mr. Boult's. I also do very thoroughly believe in the great advantage of concrete for the whole surface of the floor when you want to shut down noxious vapours from the earth.

ADJOURNED DISCUSSION.

[Held on Monday, 20th February, 1882, Ewan Christian, *Vice-President*, in the Chair.]

E. C. ROBINS, F.S.A., *Fellow*.—Mr. Chairman, it may be well to remember that this is not the first time that this subject has been discussed here, nor is it the first time that we have been favoured with Mr. Boult's opinions upon it. At the General Conference of 1878, Mr. Douglass Mathews read a Paper on the "Model By-laws as a basis of a General Building Act." On this occasion Mr. Honeyman of Glasgow, and Mr. Boult of Liverpool, also contributed Papers. Mr. Mathews reminded the meeting that at the previous Conference of 1876, two years before, the subject of General Building Regulations was introduced in a Paper by Mr. Honeyman of Glasgow, in which he called attention to the

unsatisfactory state of the present system of building requirements, and the desirability of a Building Act to apply generally throughout the United Kingdom. Mr. Clarke, of Liverpool, followed with a Paper bearing on the same subject. And the Local Government Board having under its consideration at that time, viz. 1876, a Code of By-laws, the Conference concluded with a resolution to the effect:—"That the Council of the Royal Institute of British Architects be requested to appoint a Committee to consider the subject of General Building Regulations for the United Kingdom, which shall communicate with the Provincial Architectural Societies and the Local Government Board, and report at the earliest period to the Council." All this was done, and the proposals of this Institute were communicated to the Local Government Board, who embodied so many of the recommendations made as they deemed expedient. Mr. Mathews then proceeded to make a careful analysis of the new By-laws, pointing out many inconsistencies in principle and in detail. Mr. Boult's present Paper is, therefore, a return to the discussion of an important question, after four years incubation, and is, perhaps, preparative to the resumption of the subject by the Institute at the next General Conference. In his previous Paper of 1878, Mr. Boult first laid down what he termed axiomatic principles, four in number, which he followed-up with seven other principles not so axiomatic, the acceptation of which he deemed essential before entering upon the consideration of the Model By-laws as a basis for a National Building Act. His present Paper would seem to be an elaboration of the previous one—a record of his latest opinions. It will have been observed that Mr. Boult recommends a Building and Sanitary Act combined, whereas Mr. Honeyman preferred to have them separate. Personally I think it matters little whether they are separate or associated, provided always, they seek to enforce broad principles of action and do not descend to petty details, which would at once denationalize it and hinder progress. Centralization and uniformity of procedure is all very well when thus contrived, but it should be left to local requirements and the growth of scientific appliances to determine minor details. If I rightly understand Mr. Boult's remarks under the head of "Essentials and Non-essentials," he is of the same opinion, and therefore I need not further dilate upon the general principle which forms the first division of his subject. As to the second division, viz. the particular principles themselves, which should form part and parcel of the Act, there will of course be much divergence of opinion, whether the Building and Sanitary sides of the question are associated in the same Act or not. In laying-out land for building the density of the population must be taken into account, whether it is calculated by the area for ordinary buildings, and by the cubic space for special buildings, or either for both, because the statistics show that in proportion to its density is the death-rate diminished or increased. Dr. Farr has shown "That the nearer people live together the shorter their lives;" and Dr. Playfair has shown that whereas before the Great Fire of London 80 persons died annually out of every 1000; after the fire 40 in the 1000; and at the present time, owing to the sanitary improvements of late years, and the increased prosperity of the masses, it is but a little over 20 in 1000. It is idle to ignore these facts, or to quote exceptional cases to disprove a general principle. As to "unbuilt areas:" It cannot be advantageous to have no back areas to houses. No widening of streets will ever compensate for the loss of means of light and air in the rear of buildings, unless the houses are but one room deep; but a better substitute for a lot of small areas will be either a 20-feet wide back street, or a quadrangle or common garden, such as

those at Notting Hill and elsewhere. Mr. Boult's strange assertion "It is useless to provide the means of ventilation for people who are not intelligent enough to use them," augurs ill for the future. Are we all to work down to the level of the lowest intelligence, or are we not to educate our constituents by anticipating their intelligent requirements and providing for them? As to "damp-courses," Mr. Christian has shown the practical way of dealing with them, and I will take this opportunity to refer to some recent experiences of my own in reply to Mr. Boult. As a member of the executive Committee of the City and Guilds of London Institute, I had the advantage last month of accompanying Professors Armstrong and Ayrton in their inspection of the laboratories of the Technical Schools in Switzerland, Austria and Germany. While at Munich we paid a visit to Dr. Pettenkofen's Hygienic Institute, which contains very perfect chemical and physical laboratories for the scientific investigation of all matters relating to Hygiene. It is there that Officers of Health obtain their certificates of competency on completion of their terms. I afterwards spent a couple of hours with Dr. Renk (Dr. Pettenkofen's chief assistant) in examining the process and the results of his two years experiments on the passage of air and moisture through various building materials, and of the ground air through the basements of houses. He has promised to send me his Paper on "Sewer Gases" as soon as it comes from the printer; and in a letter received since our last meeting, he has sent me the substance of a Paper "On the entrance of Ground Air into Houses," which he read at the General Meeting at Saltzburg last year. Dr. Renk's experiments have been made with a "differential manometer invented by Recknagel," by means of which he discovered that in a house at Munich the air in the ground under the pavement of the cellar was always under a higher pressure than the air of the cellar; from which result he inferred that the ground air is always in motion—from the subsoil through the pavement into the house, the pavement being permeable by air, as in this case, which (like most houses in Munich) was paved with bricks flat in mortar. The higher pressure of the air under the basement being caused by the difference of temperature between the inside and outside air, and also by the wind; for although Dr. Renk was not yet able to explain all the phenomena, he could, nevertheless, state that the air under the pavement reaches a higher pressure if wind is blowing than during still weather. An accidental circumstance led to further interesting results. In and under the basement pavement of the said house is situated a draught channel for ventilating purposes, well constructed in bricks and mortar, and covered with stone. This channel is connected with the chimney of the steam boiler, from which the house is warmed by steam pipes. This draught channel had an extraordinary influence upon the ground air, through the walls of which channel the ground air was drawn and carried by the current to the heated chimney. To the distance of six metres from the channel Dr. Renk found that the ground air was more attracted by the current of air in the ventilating channel than by the house itself; and thus he reasoned that within this space of six metres the ground air could not escape into the house, but that on the contrary the air of the cellar was drawn away with the ground air, and this result increased as the distance from the channel diminished. These experiments suggested to the Doctor the means of keeping ground air out of houses, which he is about to apply in the following manner:—"Provide and lay tubular channels of some highly permeable material under the pavement of a house, and connect these tubes with the chimney of the kitchen fire. The kitchen flue having always a strong upward draught, the ground air will be

drawn out of the soil and carried into the air above the roof." Another interesting observation was made. If the wind blowing entered the cellar of the house in which the experiments were carried-on through a window or other opening, and the air could not escape, then the air of the cellar itself came under a higher pressure than the ground air beneath it, and thus the cellar air was forced into the soil. This is the only case in which the exchange of air between house and subsoil is inversed, the ordinary route is by the indrawing of the outer air through the subsoil of the house. These experimental tests were very pretty to see, for example:—a tube was thrust into the ground just below the pavement of the basement floor, and was connected by other tubing with the manometer. This tube was provided with a stop-cock, on turning which the ground air passed through, and the pressure of the air was registered in millimetres. On closing the stop-cock the pointer returned to its former position. The passage of air through walls was thus shown:—a block of ordinary building materials, 18 inches diameter and 18 inches thick, was fitted with a metal cap on either side, having air-spaces between the caps and the material. Air at different velocities was passed through a central aperture in the cap on one side, and measured and timed as it came through a corresponding aperture in the other. I may say that by simply blowing in at one side, a light was extinguished opposite the aperture on the other side, by the air passing through the solid blocks.

J. DOUGLASS MATHEWS, *Fellow.*—Mr. Chairman and Gentlemen, the Paper of Mr. Boult has brought forward many points that were raised here in 1876 and 1878, both for and against, and also some new matter which I think is quite worthy of consideration at this time. I quite agree with him in many of his remarks, and more especially as to what he considers to be the arbitrary clauses in the By-laws which, we may assume I suppose, to be the basis of a future Building Act. I take it that that is what Mr. Boult means. It appears to me that these By-laws have been drawn more with the idea of keeping down what may be called speculating builders rather than of promoting good building; but although they may have their advantages in putting the reins on some of the men that we know perfectly well require to be held tightly, they fetter those who desire to build in a proper manner, by putting restrictions upon them which in many cases are altogether unnecessary; and I cannot help referring to a remark which Mr. Gordon Smith made at the last meeting: that "the architect's business is to get over difficulties." No doubt the architect's business is to get over difficulties, but when we are talking about Acts of Parliament it seems to me to assume the possibility of evasion by cleverness or experience. Now I venture to think that that is not the architect's business. He should do all he possibly can to assist the powers that be, and endeavour to act as a loyal subject rather than set a bad example; and therefore these laws should be made so clear that there should be no difficulty at all in executing them properly. With every respect and deference to Mr. Gordon Smith, I cannot help thinking that the By-laws have been conceived more in a theoretical than a practical way, and that those who are in the habit of carrying-out similar Acts, and others whose business it is to enforce them, know what the difficulties are, and whether they are practical or not. It is a difficult matter to fully discuss Mr. Boult's Paper, because if these By-laws are to be taken as the basis of a general Act, every subject must receive attention, and although some points may seem in themselves small, yet when they are carefully considered and thought-out, they become a good deal more important than appears in the face of them. I agree with Mr. Boult that the By-laws are too much in

detail for an Act of Parliament. A general Act should deal with matters in a general way, leaving the local bodies, whoever they may be, to make such by-laws as they think may be necessary for the government of their own particular districts, because it must of necessity happen that laws applicable to one part of the country cannot under all circumstances be so to all. Mr. Boult made a remark that he thought that the business of the builder should be as open as that of a hatter or shirt-maker. With that I cannot agree. We know perfectly well that people can do just as they like about giving the full price for a shirt or a hat, and if they make a bad bargain their experience does not cost them much; but house building and buying is a very different thing. If we could be sure that every person who builds a house will reside in it, and endure all the consequences, I should be able to agree with him; but inasmuch as the great majority of houses are built by one person for other persons to inhabit, and the greater part by speculating builders, whose object is to sell them and get as much out of them as possible, quite regardless of the future, the case is altogether dissimilar. We are well aware that, especially amongst the very poor, it is of the greatest possible importance to them to get houses at the very lowest rent, regardless of those things which are necessary to make a house healthful and comfortable; and, if we uphold such a system, we are of necessity encouraging sickness and disease, which in their turn increase pauperism and crime. Therefore the government should impose such restrictions that will tend to reduce these misfortunes, and, in addition, the public has a right to expect that buildings shall be erected in such a manner that accidents to life and limb will not ensue. In reference to the sizes of areas, the By-laws not only require areas of 150 feet as a minimum, but also that the width between buildings shall be regulated by the height of the buildings. That is a matter which I think requires a great deal of attention, for however desirable, it will interfere in large towns with the utilization of a great deal of land. Another remark made by Mr. Boult is also important, and one upon which he could give us much information; and that is, that no mention was made in the By-laws as to the scantlings of the timber, or the strength of the iron to be used in building. I believe the Liverpool Building Act enjoins certain scantlings of timber, and strength of iron, &c. I should like to know whether that has been found to act properly. In many cases it seems to me there will be great difficulty in carrying-out a table which, although perfectly right in itself, would, under special circumstances—as for instance, if the materials were inferior—be rather detrimental than otherwise. If the minimum is given for inferior or ordinary materials, then it would press hardly upon those who use the best materials. Mr. Boult seems to think that the walls, as described in the Model By-laws, are complicated. I cannot, however, agree with him; I think they are carefully set out, but for some reason in every case the walls are thicker than required by the Metropolitan Building Act. It may be marvellous how some of the walls stand, but still it is a very exceptional thing for an accident to arise from the thinness of the walls. The By-laws require that the set-off should be at the floor-line instead of the under side. It affects buildings in this way: the Metropolitan Building Act allows a storey 10 feet high in brickwork 9 inches thick; but as the set-off ought to be taken from one floor-line to another floor-line, it reduces the storey to 9 feet 3 inches. The Local Government Board require cross-walls to be carried from footings to top of the building; whereas in the Building Act it is only two-thirds of the height of main walls. Recesses are allowed to the

extent of half, but in the By-laws to only one-third of the area. On the matter of plans and drawings I find that in the Paper of Mr. Honeyman he made this statement: that in 1875, 657 sets of drawings, representing 3285 sheets, were lodged in Glasgow alone, exclusive of the suburbs. The opinion on this matter I ventured to make, was stated in my Paper. This is an important matter for architects. Only to-day I heard that in one district in which the By-laws are in force, the local authorities positively required that the elevations should be furnished, as they were an absolute necessity. That goes to show what may be expected of us. All one would think that could be required is asked-for in the By-laws, but that not being deemed sufficient, even the elevations are to be submitted for approval. That is not putting architects in their proper position, and I fail to understand the reason for these extraordinary requirements. It becomes a very serious matter, as pointed out at the last meeting, when plans have to be prepared, and consequently paid-for, as the only reason stated is in case a building is not carried-out as proposed, then the drawings can be referred-to as evidence. The carrying the Act into effect seems to be a matter which has occupied the attention of many. I think that, with the public and with builders generally, there is more confidence in practising architects than in the officers of a local authority. In small towns there comes a difficulty, because there is not the same opportunity of obtaining men in practice, and therefore it would be almost a necessity to appoint an officer. It seems to be the opinion of architects, the outside public and the Local Government Board, that whoever is intended to carry-out these regulations should be himself a certified surveyor, and pass a proper examination. In these days of centralization I think it is of consequence that local bodies should maintain as much in their hands as possible, and therefore they should be the authorities to enforce the laws; although it is right that there should be a superior body to exercise control or supervision. I think Mr. Boult's suggestion of a Board of Appeal would be a wise one. I observe in the By-laws no mention or special provision made for temporary stages or platforms, or construction of public buildings, beyond thickness of walls and adequate ventilation. These By-laws are prepared in accordance with the Public Health Act, and that Act comprises a great deal more than the By-laws convey. Now, if there is to be a general Act, it is of consequence that everything pertaining thereto should be embodied in it, so that persons having to do with that Act should know exactly what is expected of them. If a general Act is really desired, it would be well to discuss the matter at the next Conference, and if in the meanwhile the Institute would put itself in communication with public bodies and their surveyors, and all interested in the carrying-out of the Act, it might be productive of good; and no public body is so well qualified to obtain the required information, and generally to deal with the Act in a practical way as the Royal Institute of British Architects.

Mr. ROBERT RAWLINSON, C.B.—This question of a general Building Act has not come through my fingers in connection with the preparation of building by-laws; I have, however, paid attention to some of the remarks made since I entered this room, and I feel bound to agree generally that any Building Act to be of use must have a very wide range. I also agree with what has been said about not going too much towards centralization. A general Building Act, to be applicable in all places, must be suggestive rather than definite, and it must necessarily have a taint of what is termed centralization, that is, it should be framed by a central authority. With regard to the difficulties of observing hard-and-fast

rules, I have had sufficient experience in my department to avoid these as much as possible, and those who have paid any attention to such Papers as have been issued from the Engineering Department of the Local Government Board and drawn by myself, will see that I have abstained from making hard-and-fast rules in any case. The instructions to surveyors and sanitary engineers issued by the General Board were termed "suggestions," because I knew how difficult it was for me, whatever my knowledge might be, to dictate to others who were carrying-out similar works under different conditions that I could not be acquainted-with, and therefore I contented myself with giving general suggestions, based, however, upon practical knowledge, and a wide and varied experience in devizing and executing works of main-sewerage, house-drainage and water-supply. Regulations for buildings, to be useful, must also be drawn by a man or by men of wide and varied practice, and to be acceptable must be in the form of suggestions, so that modifications may be possible. However we may have progressed in other departments, in engineering and architecture we have not attained to the stand-point of the Medes and Persians. A perfect Building Act you cannot hope to make, but one that would be most acceptable would be one drawn in a spirit that should give general details and instructions upon which local By-laws might be framed, and certainly would avoid going into structural details as much as possible. Take for instance the structure of house water-supply fittings. By-laws sent for approval have been submitted to me to put them into proper order, and generally I find that the country surveyor takes single types of a water-closet, a service-box, or tap, or pipe, and describes the make of each minutely, but to embody such details in By-laws would be manifestly an improper way of doing business, as it would be unjust to the trade in general, because it would be playing into the hands of the maker of those special types, when I know that there may be a dozen types each one as good as the other, but differing in details. But what should By-laws do? They should simply describe that the apparatus shall be the best of their kind in the most general terms, and say nothing about the details of construction. With regard to sites of houses, I do not know how any general law is to dictate as to sites. I have had a pretty wide experience, and find houses built on sites that it is difficult to sewer and drain properly, but if you debar building upon such areas you will stop the growth of many towns, and perhaps, in some cases, very properly, but not always justly. Let me take this great City of London. How many scores of acres are built-over on the west (Belgravia), the southern and the northern sides, upon sites that must have been inevitably condemned, if a hard-and-fast rule against low sites were laid down. That portion called the Isle of Dogs is 10 or 12 feet below high-water mark. A portion of West Ham and a great portion of Bermondsey are also below high-water line, and yet these sites are sewered and drained by a use of steam-pumping. If you stipulated that no site should be built-upon below high-water mark, I do not know a seaport in England in which you would not prevent great areas from being used for building. The river sides of Belgravia and of Westminster were swamps, but they have been built-upon. And what are we to say about Holland? but that these low sites involve embanking, piling, concrete and pumping. Again, to return to the subject of the Paper under discussion, let us consider the working of building By-laws by independent local authorities, and what do we find? How are Local Boards constituted? Who are the persons elected upon them? Are we quite sure that all those gentlemen who give their time gratuitously to manage local affairs do it "free, gratis and

for nothing"—have no interest direct or indirect in sitting upon these boards? Have they nothing to do with the buildings that are going to be erected or managed? You will find a proportion of them are persons concerned in building. They are either cottage owners or they are persons who wish to be cottage builders, and they do not, in all cases, act with singleness of purpose, as some local surveyors find to their cost. The first Public Health Act provided that a local board might appoint its surveyor, but that they should not discharge him without the consent of the General Board. That was supposed to be a protection to the local surveyor, that he might do his duty independently. What was the result? There was such a general outcry against that reputed dictatorial interference of the General Board in having this power, that when the Public Health Act was reconstituted in 1854 or 1855, that clause was repealed, and surveyors can now be appointed and discharged by any local board, independently of the General Board. Having suggested censure as to the action of some members of some local boards, I feel bound to say, on the other hand, that I never cease to wonder at the amount of time given gratuitously to local-board work by men of honour, ability and integrity, who seek nothing but to do the best possible for the locality. Hence my desire to see local authority strengthened, rather than superseded by central departments as in France. As you are aware the whole of England and Wales is subdivided into urban and rural districts, and the rural districts are empowered to devize and carry-out works of sewerage, &c., just as urban districts are. And what do some of them do? They send plans to the General Board prepared by an Inspector of Nuisances, probably so rudely and defectively made that a boy out of a fifth-form might make as good a plan with a pen-scrawling upon paper, and upon such a plan as this it is expected a loan is to be advanced for carrying-out a system of main-sewerage or water-works, or other general improvements. The central Board is not an executive board. We have no establishment for making surveys with proper plans and details. There are no such means put at the disposal of the General Board. There have, however, been prepared and published some broad and general instructions which are called "suggestions." Those are sent down to the local authorities, and they are directed to apply to some educated surveyor, and to get their plans properly drawn, details and estimates properly prepared, and then to submit the same for inquiry, and if found reasonable for approval and sanction, before they can have a loan. Some of them take the advice, some of them do not, and then the central Board is accused of putting a block to sanitary progress. Taking another feature of central and local collision, I have been frequently met with the assertion that there ought to be more absolute power for doing certain things, that is to say, for acquiring lands or other properties compulsorily, that is, taking possession of other people's property, if required for public purposes, by a short, swift and arbitrary process. I appeal to you, Gentlemen, if you ever expect that any government will give such arbitrary power. It may amend the existing process, and it needs mending, as I do not know anything more round-about and costly than action under the Lands' Clauses Consolidation Act, for the acquiring compulsory powers to settle disputes as to the value of property. The machinery dictated by the Act is both cumbersome and costly. It is quite possible to litigate about £500 and spend £5000 to attempt to settle it. At any rate, extravagant costs have been incurred over and over again. When I have been summoned on an arbitration it has, at times, made my heart ache to see the assemblage for the first day's process. The room filled with barristers, solicitors, surveyors and others, without stint or control.

One side to swear one thing, and the other side to swear the other, and probably the first day's costs may involve more money than is in dispute. It is quite time that an arrangement was made to settle arbitration disputes better and cheaper than at present. I may be accused by some people of speaking against business, because nothing is more profitable, as barristers, solicitors, architects, engineers, surveyors and valuers know, than to be summoned on a good rattling arbitration; they are paid well for attending, and if the case goes over many adjournments and lasts many days, the witnesses get money easily, but I am sure any right-minded person must regret that there is such a roundabout way compulsorily to settle matters which ought to be decided more easily and with far less cost. With regard to areas to be occupied by houses, I do not exactly know how one is to regulate or define specially what areas shall be kept in future. I do, however, know that if a Building Act, or any other general Act, did nothing more than to prevent areas already existing being abused, it might do a great deal of good. I assure you I know towns that have been absolutely over-built and over-crowded in the most shocking manner. They have been so fearfully over-crowded, that is to say, there were closed courts the size of this room, entered by a narrow passage from the street, not more than 3 feet 6 inches wide and 9 feet high, the court closed-in on all sides, and yet additional cottages have been built on the space, leaving a passage of about 3 feet all round; I know also one unfortunate town (and it is not one alone that is so situated), which, being surrounded by entailed property belonging to a great nobleman, who would not enfranchise it because it would make radical votes, was made unwholesome by being overcrowded as described. I know Mr. Boult's kind and benevolent heart must have ached again and again at the miseries he must have seen in his native town, Liverpool, as no town was more horribly mismanaged than Liverpool some half a century ago. There were cellar dwellings having the ceilings below the level of the street pavements, and narrow courts run up in the most crowded manner by what were termed "jerry" builders, who were permitted to build cottages in courts and narrow streets without any let or hindrance, to breed disease and give Liverpool that notoriety of unhealthiness to which it attained. The Corporation has, however, since then obtained one or more Acts of Parliament to enable it to buy portions of that property for the sake of pulling it down. I, in my innocence and ignorance, was positively foolish enough to buy some of that class of property, but fortunately the Corporation has taken half of it and pulled it down—the other half I now hold; to do my duty by it regularly requires about one-third of the rent to be expended on repairs and maintenance. There are, however, scores of cottage owning landlords who are not so conscientious, and the result is the tenants suffer by the neglect. Then there is that back-to-back principle, which crowds cottages on the smallest space of ground, and affords no means for through ventilation. This class of building should never again be allowed. When I go into the country, away from the region of By-laws, I see villa residences rising, provided with scampered timbering joists, inch or inch-and-a-quarter thick, which singly twist and bend, and I also see rows of cottages being built on the soil which has not been removed—the bricks of a spongy character; the mortar, road-scrapings mixed in some cases with a little lime; and it has been said, "do not interfere, because it is the custom of the district, all the cottages having been built in this manner, and some may be a hundred years of age." These mud-built cottages are comparatively dry or damp, just as the weather may be, but are ever more or less

damp. You want a law to reach that kind of building, but when you have the law it will be of no use unless it is properly administered. You may have laws the most perfect, but their utility depends upon those who have to execute them, whether justice is done to them or not. Therefore evils will arise which we cannot help, and which we must consequently endure. For all that I do not want any more centralization, as I think we have quite enough of it, and I speak as a Government officer—I have not the slightest desire to see this country saddled with any additional arbitrary centralization, for we had better a great deal suffer some evil than be overridden as they are in France, where you could not raise a paving stone, nor do anything in the form of municipal work other than through a Government appointed official. Though as stated we have some bad work done, yet there is an enormous deal of good work being done, and the discussion in this room, embodied as it will be in your TRANSACTIONS, and read as it will be by your members, and distributed, as I also hope it will be, will tend to do a great deal of good. It is only by framing and then discussing the best laws we can produce, and then distributing and re-distributing the knowledge so provided, that we can attain at anything like practical utility.

MR. W. GOLDSTRAW, Surveyor of Buildings, Liverpool.—Knowing Mr. Boult as I do, I am sure he will forgive me if I say that it is quite a natural reflection that that excellent Paper, dealing as it did so fully with details of building and sanitary construction, dealt very much more with building and sanitary regulations than with the question of uniformity. I must say (and I say it with great diffidence) that I was a little disappointed in not hearing more about the question of uniformity. And in the discussion this evening it seems to be taken for granted that some sort of general Building Act is about to be imposed on the country; and it does not seem clear whether there is a decided opinion in the meeting that a general Act is either desirable or necessary. I say "either desirable or necessary" because Mr. Boult draws a very special distinction between what he calls "essentials" and "non-essentials," or things desirable only. It is a most important question whether a general Building Act is required at all. Venturing, in all modesty, to give my own opinion, judging from what I see in Liverpool and the neighbourhood, I think it will be a great boon to the country to have a general Act. In Liverpool we have a Building Act which has been in existence forty years, and which is not at all like the Metropolitan Act. Consequently, gentlemen practising in London, when they come to Liverpool, sometimes make unfortunate and costly mistakes. And it is pitiable to see good money wasted and good men's tempers spoiled by these discrepancies between two important Building Acts. That happens more or less throughout the country, because there are very few places that can fairly be said to agree as to their building regulations. So that gentlemen who practise in different parts of the country must, I am sure, find the same sort of difficulty. I can hardly help saying that it is to my mind marvellous that such apathy apparently exists amongst architects as to this want of a general Building Act. Whether the number of different sets of building regulations is 2,000 or 3,000, it must be a great waste of power and a constant source of annoyance that so much confusion exists. I think the architectural profession ought to be positively grateful to the Local Government Board that it should take such trouble to frame Model By-laws and bring them into use, so as possibly to form the basis of a general Building Act in the future. Speaking of the Model By-laws as the basis of a general Building Act, are there not some

questions that such an Act ought to deal-with which are not included in them? Reference has just been made to the strength of joists, &c. Now, in those By-laws nothing is said about the strength of timbers, so that it becomes a serious question whether the strength of timbers in floors and roofs ought not to be specified in any Building Act. In Liverpool that has been the case ever since the present Act came into force. The strength of the timbers for floors and roofs is clearly specified, and I have not heard any complaint about it, because the rules are perfectly understood. That want of reference to strength of timbers is to some extent a defect in the Model By-laws. Some suggestion has been made as to the advisability of the Institute collecting information from different parts of the country with a view to a general Act. And I have heard it stated in this meeting that a committee did sit for that purpose some years ago; but it appears to have been a committee specially appointed to consider the Model By-laws. As a Corporation official, I venture to suggest that perhaps this is a work which might very well be done by the Royal Institute of British Architects. I do not know that there is any other body so well fitted to do it, and I am sure the results would be wholly beneficial. As to the question of details in the Act, Mr. Boult said he thought the terms in any new Building Act should be general and wide, and that all details should be avoided, and in order to give point to that opinion, he specially mentioned mortar. He said he thought the proportion of mortar ought not to be specified, and there I venture to differ from him. In Liverpool we have requirements as to mortar, and as to the ingredients of which it should be composed, and their proportions. Builders there are summoned, and are often fined and ordered to have their work pulled down, for not attending to these requirements. If these matters were not specified, I am sure it would be utterly impossible to carry a case through a police-court. We could not give evidence before the magistrate as to the quality of the mortar. A question would arise as to what is good mortar; and a vague wording of the kind suggested would be unworkable. For the carrying-out of such an Act Mr. Boult evidently inclines to the system of district surveyorship which has long prevailed in the metropolis. If my opinion were asked, I would venture to say that if that system were introduced into Liverpool it would have a most pernicious effect. Speaking of the London system simply as a theory, I would venture to say that the objections which apply to pluralisms in the church and to polygamy in society seem to me to apply, with more or less force, to the system of allowing public officials appointed to carry out a public Act to have a private practice of their own. If you will excuse me for thus speaking in the presence of gentlemen who know much more about the London system than I do, I would say that when district surveyors were brought into being there was no Metropolitan Board of Works or other similar body. If I am wrong, I am open to correction. In 1774 there was passed an Act of Parliament in which it was laid down that practising architects should be appointed district surveyors. In 1844 the same system was renewed; and in 1855, when the present Metropolitan Building Act was passed, that same system which the Act found in vogue was continued and specified in that Act of 1855. It should be remembered that the Metropolitan Board of Works was only brought into existence by an Act passed in the very same session in which the Metropolitan Building Act became law; and if the Board had been in working order before the Building Act was passed, it is doubtful whether some other system would not have been substituted for that of district surveyors.*

* First of all, Is uniformity desirable? It may be safely affirmed that it is, or that there is great necessity

Dr. THORNE THORNE.—Mr. Chairman, although I belong to a profession which has rather prided itself in having included some prominent members who, with architects, engineers and others, have done some little at least towards the promotion of public health, I have been aroused from any sense of satisfaction as to this by what Mr. Boult has said in his Paper, viz., that, as "the result of forty years' empiricism," he has come to the conclusion that "the deplorable state of sanitary science," is due "to the undue influence accorded to members of the medical profession and other theorists." Notwithstanding this, I feel sure you will be good enough to bear with me whilst I make some short reference to one or two points, with a view of inducing you to withhold your assent to some of the opinions expressed by Mr. Boult. I am often called upon, with my colleague at the Local Government Board, Mr. Gordon Smith, to go into different parts of the country to explain to sanitary authorities certain of the more medical points involved in the Model By-laws; but as I had absolutely nothing to do with their preparation, and as I never saw the By-laws until they had been issued to the public,

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for a general Building Act. This necessity is the outcome of the inconvenience arising from the great number of contradictory statutes and by-laws. Mr. Boult has put the number at nearly 2,000. That is, 2,000 distinct and varying sets of building regulations for the various districts, both urban and rural. But when we bear in mind that many towns possess several different Acts of Parliament and by-laws dealing with this subject, the true number is probably nearer 3,000. In some large towns the regulations affecting buildings have to be collected from eight or nine separate statutes; and the number of those persons who are fully acquainted with them may almost be counted on the fingers of one hand. A general Building Act would insure not only local consistency, but general uniformity throughout the country. Next comes the question, If such a measure is expedient, what are the particular subjects or topics with which it ought to deal? Mr. Boult appears to favour a general Act, but would leave out of its scope certain matters which others would include. The following appear to be essential topics in any Building Act:—

1. The materials of walls and roofs.
2. The thickness of walls.
3. The separation of buildings by party walls.
4. The construction of chimneys and flues.
5. The provision of open spaces for dwelling-houses.
6. The dimensions of rooms and windows of dwelling-houses.
7. Projections beyond the regular line of buildings.
8. Ruinous or dangerous buildings.

But are there not yet other subjects which it is requisite or at least very desirable to include? Take the following:—

A. Foundations of domestic buildings.
B. Damp-proof courses in houses.
C. Limits of height of houses.
D. Means of egress from all large buildings, including hotels.
E. Warehouses for combustible goods.

After settling the subjects of the desired legislation, one of the first principles to which to give effect is that the prohibitions and requirements be clear and positive. This will necessitate the enactment of details, more or less. It is impossible to administer regulations unless they are precise. And, for the sake of uniformity and certainty, as well as for other and obvious reasons, very little should be left to the discretion of the surveyor. In some things, however, the surveyor's judgment must decide, because rules cannot be laid down. Not to name these cases, it is enough to mention that dangerous buildings are an example of one class. These, then, appear to be pertinent questions for discussion:—

1. Is a general Building Act wanted?
2. If so, what should be the subjects of its main provisions?
3. Should those provisions be expressed in general terms or in detail?
4. Should the officials who administer the Act devote their whole time to the public service?—W.G.

I feel sure I may be freed from all suspicion of having any personal grounds for upholding them. A good deal has been said with regard to the concreting of the sites of dwelling-houses, and it has been held by some speakers that this is a very arbitrary thing to demand. One speaker has referred to some scientific authorities who have pointed-out the advantages which accrue to those who live upon a dry soil. Many other authorities, including the present medical officer of the Local Government Board, may be added, for they have shown how disease is promoted by residence on a subsoil which is damp and from which the air has free access into the interior of houses. But it is not only with regard to that one point of dampness that this By-law has been laid down. One speaker has said that it might be necessary to have a concreted site, provided the site was damp, but that it would be unnecessary in the case of rock, gravel, and porous soils. I would maintain that in an important sense it is almost more necessary in the case of these latter soils than under other circumstances. It is frequently my duty to inquire into the origin of outbreaks of infectious disease, and I have found in some admirably constructed houses how typhoid fever and diphtheria have broken out by reason of a leakage from a neighbour's drain or from some neighbouring cesspool into the porous gravel or fissured chalk soil beneath the foundations. In such cases, the moment the house is shut up and its temperature rises above that of the soil, the foul air from the contaminated subsoil freely passes up through any ordinary flooring into the interior of the dwelling; and for this reason alone, I say it is as necessary, if not more so, to have a concreted base in the case of a gravel soil as in the case of a damp clay. These Model By-laws, however, so far as I know, are not laid down as hard-and-fast rules, and my experience with regard to that one which relates to the concreting of the soil beneath houses may be taken as typical of many of them. Thus, I have often explained to sanitary authorities how pthisis and such diseases as typhoid fever might be prevented by the adoption of this By-law; and the Local Government Board, have, on learning this, felt that, since the points already adverted-to have been fully explained, the local authorities may be left to act upon them, either by the adoption of the By-law or by modifying it to meet local circumstances, or even by leaving it out altogether. That has been the policy of the Board under such circumstances. The By-laws do not profess to be anything but what they are called—"Model" By-laws; and being so, it is not intended that they should necessarily be followed in every single detail. With regard to the ventilation of drains, I cannot conceive anything more likely to injuriously affect a house than to bring the foul air from the sewers near to the top of the attic windows, as would, as a rule, be done by allowing rain-pipes to act as ventilators to the public sewers. I have lived in a house for many years having a ventilating opening to the house-drain on the house side of a "syphon" trap which shuts-off the air in the public sewer; I have also carried my soil-pipe above the roof, without reducing its diameter. I have thus a house-drain open at both ends to the outer air, and by this means I have insured a current of fresh air through the whole course of the drain. The resulting experience is that I would never again live in a house into the drains of which the foul air from the sewers could make its way. Where the rain-pipes are used as sewer ventilators, as proposed by Mr. Boult, I have often, where there have been epidemics, found that the spread of infectious disease has been favoured by the fact that the rain-pipes have conveyed into the vicinity of windows the air from infected sewers. The time also at which the largest amount of foul air should be forced through ventilators is necessarily

that when the sewers are filling most rapidly—in other words, during a heavy fall of rain. The rain-pipes are, however, then being used for a totally different purpose to that intended by the author of the Paper. The greater part of their sectional area is occupied by the descending water, and instead of there being an up-current, it is in the opposite direction, and ventilation is hindered or stopped. But by whatever method this foul sewer-air is allowed to pass, as Mr. Boult suggests, into and through the house-drains, danger will certainly result. It is not long ago since a very able Queen's Counsel thought he would like to ventilate his house-drains. It did not occur to him that two openings were necessary for real ventilation, and, without first cutting-off the passage of sewer-air from the public sewer by a trap, he continued a soil-pipe up above the roof. Some time after, the plumber's work began to give way a little at the junction of the ventilating shaft with the soil-pipe beneath the closet-seat, and the foul air streamed in at the leaky joint. Two members of his family died of diphtheria. Such a result could never happen where a current of fresh air through the house-drains, as provided-for in the Model By-laws, is insured. Then, with regard to open space about houses. Mr. Boult thinks that this is unnecessary, and he says that those spaces he does know are constantly damp, that they become harbours of filth, and that noxious effluvia are generated in them. To my thinking, it is a thousand pities we have not more open spaces about houses. One great curse of our large towns is the overcrowding of dwellings upon area. Even granting the unintelligent condition of the people, it will only require a short time to educate them to appreciate the value of open spaces, and it is the duty of the sanitary authorities to see that the use of these spaces is not abused. The abuse of a good thing ought never to be brought forward as an argument against its proper use. But Mr. Boult goes on to say: "It is useless to provide for ventilation if people are not intelligent enough to make use of it." I can hardly conceive that he intends to convey the meaning which his words imply. It surely never can be the duty of scientific bodies to bring their advice down to the low level of the ignorant classes. It ought rather to be our object, in all professions, instead of lowering the standard of our advice, to endeavour to educate the unintelligent by reason of such advice to appreciate the value of improved sanitary regulations, which tend to promote health and comfort. So far as these Model By-laws are concerned, I have often been struck with the remarkable educational effect which they have had, and I may say, as the result of some fifteen years' experience in different parts of the country, that I hardly know anything which has so improving an effect upon the public as to surround them with good sanitary conditions. In the colliery districts, I have been told that to provide properly for the sanitary wants of the inhabitants would be useless, as "the people are dirty and filthy in their habits." I have invariably retorted: "You having by your inaction failed to provide the people with means by which they could live in cleanliness and decency, have now no right to turn round and say they would not know the value of living under proper sanitary conditions." In short, it is precisely the educational influence of efficient sanitary by-laws that is slowly doing so much good.

Mr. E. B. Ellice-Clark, Assoc.M. Inst. C.E.—Mr. Chairman, I would, as an official executing by-laws very similar to the Model By-laws, try to emphasize one or two remarks made by the previous speakers—as to the necessity of detailed provisions, especially, by Mr. Goldstraw. Mr. Boult states that he would not make any detailed provision with regard to mortar. It was my misfortune last Monday to prosecute six builders, for using what was called mortar.

Now, in the Hove By-laws the word "mortar" only is used, and in the Model By-laws there is a definition of mortar. The mortar in question contained in my judgment about ten of gravel and loam, and a little sand, to one of lime, and yet there gave evidence against the local authority, two members of the Building Committee, who said that mortar containing five or six of aggregate to one of lime was good, and would put up very good rubble walling. This illustrates the great difficulty a local surveyor has to carry-out his duty, where he is appointed by a local authority, and has no appeal as to his dismissal—he has commissioners actually going into the witness-box giving such evidence as that. If you made a general Building Act, and did not make a specification, it would be impossible to get a conviction. I think Mr. Boult makes a mistake in imagining these By-laws are made to control architects. Ninety-five per cent. of the buildings in towns have been erected without any architects whatever, and I can say that the architects, in the great majority of cases, build far beyond the requirements of the Model By-laws. In West Brighton, where frequently a number of London architects are employed, it is a rare thing for my building inspector to go and see their work and find fault. These By-laws are made for speculating builders, who must be controlled. I have seen thousands and thousands of houses put up by these "jerry" builders, and it is impossible to embody in a general Act anything like the stringent provisions required to insure an honest kind of building. With regard to the air-space, which I think most important. In West Brighton, where we have a number of very large houses, where ground brings £6,000 to £8,000 an acre, we have never had the slightest difficulty in carrying-out the table which is precisely similar to that of the Model By-laws. We do insist, not only that this air-space shall join at the rear and at the side, but that it shall be a certain width across; and out of perhaps two thousand houses erected within the last five years, we have only had three or four cases where the local authority, from the peculiar circumstances, have had to give way with regard to the width across. This shows, if the air-space, as must be admitted, is important to the health of a town, the table in the Model By-laws is not a very difficult one to work. Mr. Rawlinson spoke about the houses that are below high-water line. Of course there are many systems of sewerage that are much below that, and many houses are built below river beds. When I was Borough Engineer of Derby, a large number of houses were flooded, and the local authority would not have damaged the interests of property to a great extent if they had prevented the erection of any new houses which could not be properly drained into the system of main sewers. There was a case decided in London—I think the Wandsworth Vestry were complainants; they prevented houses being built below the level of the sewer. It is essentially necessary, even though property might suffer, that houses should not be built below a system of sewers. In this Institute one must speak with very considerable caution as to the deposit of plans with the local authority. Some professional gentlemen seem to think it is rather a hardship that they shall have to deposit plans. Another gentleman has implied that the local surveyor may copy them, and thus make use of the brains he has not paid-for. I know most of the borough engineers of this country personally, and I do not think anyone would accuse them of taking the ideas of architects from the plans deposited. I am sure in the *Building News* and other professional papers you may get almost every kind of detail supplied for a very small sum indeed. The value of plans to us is this,—in dealing with a class of people who have no kind

of honour whatever: a man commences to lay down a street and he might say, "I am only going to put up two-storey houses," and he commences with a 9-inch wall. In Ramsgate and in other places he can commence with a 4½-inch wall. I know miles of streets in Lancashire where you may play a piano at one end of the street and that is a concert for the remainder. A man may commence to build a street of these houses half-a-mile in length, with 4½ inch party-walls, and go up five or six storeys. It is impossible, unless you have the plans with a section showing the height and length of the walls, for a local surveyor to control the proceedings of this class of builder. It may be a little trouble. We do not want details or elevations, but only plans sufficient to see what is going to be done. But I really cannot conceive that it is a great hardship upon intending builders, having to supply the local authority with plans. I can conceive that it is considered a hardship in the mind of the speculating builder, but I think that in making him provide plans it does a great deal towards educating the whole of his class. Where houses are built without being seen on paper at all, you know what is the result. But if a builder is bound to put his building upon paper and think it out, not harm but good must come from it. When Mr. Mathews read his Paper a few years ago, I then felt it my duty to speak very strongly against the Model By-laws. I felt, even as an official, that they were inquisitorial and impracticable to a large degree, but having grown older, and having had a little more experience of local authorities, and of what in Liverpool are called "jerry" builders, I think it would be almost impossible to check them without plans and detailed By-laws. Even as it is, they will dodge you in every possible way. I often say, if it is ever my fortune, under the present system of By-laws, to turn speculating builder, I could drive a strong coach and four through them. I only hope that, if there is a general Act of Parliament, it will not touch details at all. Details must be dealt-with locally. What we want in Liverpool may not suit London, and what is wanted in the valley of the Derwent is not wanted on the chalk cliffs of Ramsgate or Dover. The Public Health Act gives a local authority power to make by-laws as to certain matters. It requires power to make by-laws with regard to more things than there are under existing Acts. I think it would be a mistake to insist in one part of the country upon the same things that are neither essential nor practical in another. It would be impossible to embody details in a general statute unless you had an Act of Parliament that would fill volumes. I think what you do want is to enlarge the scope of the Act of Parliament which makes provision for local authorities to make by-laws. Touching upon a personal matter, Mr. Rawlinson shadowed forth what was essentially necessary. One does not speak personally, but, as I happen to know four or five hundred of the surveyors of this country, I feel that we want some different kind of election and selection of local surveyors. When I see two of my "masters," shall I say? going into the witness-box against me, and when, forty-eight hours afterwards, they may be sitting in judgment on me in a committee-room, I do think it is impossible for me to do my duty fairly and impartially in a provincial town. Although it may tend to centralization, I feel the London system, where men eminent in the architectural profession are selected for district surveyors, and are made independent by their private practice, is the best. In this I differ essentially from Mr. Goldstraw. Many of the local surveyors receive sums of £120 per annum, and it is impossible for them to fulfil their duties fairly and impartially. I would

impress upon gentlemen from the Local Government Board, having no doubt considerable influence, that they should do something in the way of securing to us, not protection, but some kind of appeal against the arbitrary suasion and influence often used unscrupulously by members of local bodies against their officials.

JOHN HEBB, *Fellow.*—I was quite prepared to learn that Mr. Boult would advocate some increased stringency in the law rather than any relaxation. I think it is rather late in the day for architects to be called on to show the necessity of having walls built with good bricks, and with mortar of a certain quality; or of covering the site of a house with concrete, or of the efficacy of the damp-course. On all these things I thought we were agreed. I do not think I need go over matters already sufficiently discussed, and slay the slain. The discussion has turned more particularly upon the Model By-laws, and these, I think, it has been very well shown, are not intended to be final. They do not become law until they have been adopted by some local authorities, and it rests with the local authority to accept them in their entirety, or to take so much of them as may seem applicable to the particular case. The By-laws are minute, so that they may meet all cases and circumstances, but are merely, I think, in the nature of suggestions for legislation. I hoped to have heard something about the Metropolitan Building Act, which, although it has been in use for some time, is considered by some people as not quite perfect. I should have been glad to have heard if there were any alterations to be suggested in the Act. The proposal that there should be one uniform law I cannot help thinking is Quixotic. It would be impossible to have one law for the whole of England. Buildings in London differ materially from buildings in provincial towns. The very nomenclature of building materials would prevent anything like a uniform code of regulations. What is called a "storey-post" in London might perhaps be called a "bressummer" in the country. The Metropolitan Board of Works, whose jurisdiction extends only to the Metropolis, can scarcely take charge of the buildings of the whole of England. The Institute is fully occupied, and would scarcely venture on a new Building Act without the assistance of some central authority. As to the Government—they have not shown any very great anxiety to reform the law with regard to building. You may remember the last attempt made to codify the law in 1875. That attempt met with disastrous failure. But the Bill of 1875 was a very patient piece of work. The late Mr. Newell, who had been engaged in the preparation of nearly all the Building Acts in force, devoted a great deal of time to it, and, although the changes were not serious, the House of Commons rejected it—amongst the most serious opponents being this Institute and the district-surveyors. In the face of that experience I think that the Metropolitan Board would be disinclined to attempt any further steps in a similar direction. But if the Institute is of opinion that there is anything in the existing state of the law which requires reformation, I am sure the Metropolitan Board will be only too glad to take any representation from them into consideration. The Board has introduced a modest bill into the present Parliament which deals with the limitation of the cubical contents of warehouses, and similar matters. The Board consider it undesirable to attempt a more comprehensive reform of the law, and they are now proceeding to deal with it by instalments. The Act of 1878 has met with pretty general approval, and the working has been of considerable benefit to the public.

HENRY DAWSON, *Fellow.*—As the discussion has proceeded, my mind has been drawn to

the various opinions expressed by the speakers respecting the necessity for a General Building Act, as it has been styled. I think it is a mistake to suppose that Architects do not want a General Building Act. In my opinion it is necessary that there should be one, provided it fulfils its obvious meaning, and that it does not descend to details. That there must be by-laws which treat of details is also perfectly clear, in order to meet those cases of vile building that will always occur with the "jerry" class of builders. Where I think the mistake is likely to be made is, if the By-laws affecting details are to be, as advocated by some speakers, applicable to buildings indiscriminately, whether an architect be employed or not. A Building Act which should treat of details, such as the scantlings of timber and the strength of iron, would fitly apply to this "jerry" class of builders, but certainly not to the architectural profession. Again, when the local government authority requires the deposit of the architect's elevations, as well as plans, it becomes arbitrary and unnecessary, and by no means a compliment to the profession. When we hear it advocated that all such details should be specified for us by an Act of Parliament, are we not tempted to fear the decadence of the human intellect, and to ask such a one as Charles Darwin, whether he has ever considered it possible that the beautiful erect creature Man, endowed with such wondrous faculties, and who, he assures us, has been raised in form by natural evolution gradually from the monkey, may not be in danger of descending again to the level of that interesting biped, for it would really seem that we are to lose all opportunity for exercising the powers of that intellect which God has given us, by submitting to a treatment only suitable to children. So that all our tedious education as architects will go for nothing. These considerations naturally lead me to the suggestion I wished to make, viz.: that there should be a general Building Act which might be made applicable almost over the whole of the country, and that therefore would be generally acceptable and easily enforced; and that there should be, side by side with such an Act, by-laws treating of particular details but which by-laws should not be enforced upon any building owner who employs a properly certified architect. If that were the case then there would be no hardship and no disrespect cast upon the architectural profession. I think it is a degradation that architects who have been properly educated and trained should have these By-laws arbitrarily enforced upon them, when there is really no necessity for it. That these minute and particular rules or By-laws are necessary for the proper erection of buildings where no architects are employed, there cannot be a shadow of a doubt. I can speak of such building operations in a town ten miles from London, where the first difficulty arose out of the composition of the mortar. On that estate there are half a dozen builders of the same kind who are building their walls with mortar (?) composed of inferior lime and nothing but garden mould; and upon my applying to the Local Board for their regulations, I found that they have none as to mortar, so that, in this and other equally important items, every little speculating builder may do as he thinks right in his own eyes. Again, I think that the requirement to deposit with the local authorities, full sets of working drawings, should be strictly confined to those buildings where there is no duly certified architect employed. Again, I consider it would be a very useful auxiliary in the inforcement of general or particular building regulations to have a proper tribunal of professional experts, —a court of appeal to which to resort in disputed cases. I really do not see why it should not be done, and I am sure it would stop a great deal of litigation. Instead of magistrates

being compelled as now to be the judges upon technical cases arising out of the Building Act, if there were attached to every district court one or two professional assessors, who would be able to afford the magistrate or judge the knowledge and experience required to enable him to give equitable judgments, it would save a great deal of the present needless expense and loss of time.

THE CHAIRMAN.—It strikes me that these By-laws are framed principally for the purpose of restraining "scamps." Honest men need not be afraid of them, and though Mr. Dawson thinks that architects should be excepted, I do not quite see it—because unless the rules are very bad, architects are pretty sure to agree with them. I can bear testimony to the truth of what Mr. Dawson has said as to the way in which buildings are erected in the suburbs of London. I have seen in houses in my own neighbourhood some of the worst work ever put together by the hands of man, and what the poor creatures will do who are to live in them I cannot understand. If we are at all right as to the results of bad building disease must spread through large districts in the suburbs of London. Speculating builders profess to insert damp-proof courses, and to concrete over the surface, but they use bad bricks and worse mortar. They put what are called dry areas outside basement storeys, but which are really collectors of wet, and the result is that the walls are perpetually damp. How are you to deal with "scamps" if you have not some rules laid down upon which a surveyor may act? I think it is a very wise precaution to make these provisions. As to uniformity, I do not think it is possible. People differ in their views, and though you may lay down general principles, you cannot have absolute uniformity in details. Climate, materials, modes of building, vary in every district, but the principles of sound building and sanitary science are the same everywhere. I think we are much indebted to Dr. Thorne for what he has said. Mr. Ellice-Clarke has converted me to some extent in what he has said about drawings, in the case of speculating builders; but I think it unreasonable that architects should be required to furnish them as I have been asked to do for the use of district surveyors. [PROFESSOR KERR, *Fellow.*—They do not ask for them. At a Meeting of the District Surveyors' Association it was determined never to ask for them. EDMUND WOODTHORPE, *Fellow.*—There seems to be great ignorance in this room as to the district surveyor.] I can only repeat that I have had to resist applications of district surveyors on this point.*

MR. JOSEPH BOULT.—I think it would be useless to attempt to reply to all the observations made this evening, or even to the bulk of them; but I think I am in courtesy bound to explain to Dr. Thorne that the remarks in my Paper to which he referred as

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* Since this statement by Mr. Christian (of applications from district surveyors to deposit plans with them) was made, another similar case has occurred, in which the district surveyor has justified his course of action. The building to be erected was a chapel, and the district surveyor informed the builder that, until he had deposited plans and sections with the former, he would not have given the notice prescribed by statute. In a further communication the district surveyor said that "deposit" meant permanent deposit, and on an appeal being made to him by the architect of the said chapel the district surveyor replied as follows:—"If you will refer to the By-laws (a copy of which I inclose you) you will find that, in the first part of By-law 5, the term used is *deposit*, when relating to the production of drawings on notice being given of works with respect to a *public building;* whereas, in the second part of the said By-law, the term used in the case of *houses* is only *produce.* Again, when the District Surveyors' Association consulted upon the interpretation to be put upon the phraseology of the 41 & 42 Vic. cap. 32 and its dependent By-laws, the conclusion was arrived-at that *deposit* meant *permanent deposit.*—See their Resolutions, 31st October, 1879, a copy of which was sent to each district surveyor." See the footnote at page 155 *ante.*

sweeping and condemnatory of the medical profession were carefully confined to some of the profession only. I have great respect for many of the medical profession; but I do think when a medical man is afflicted with the craze of being a sanitary reformer, he is one of the most visionary and tiresome men with whom you can meet. Dr. Thorne made use of the expression "overcrowding." I would ask him, as I have asked other medical men, to define to me what he means by over-crowding. Dr. Richardson, the great founder of Hygeia and the great sanitary reformer, has laid it down that there should be no more than five families to the acre—thirty persons; and the Peabody trustees crowd people at the rate of 1,500 to the acre. Now, who is right—Dr. Richardson or the Peabody trustees? The latter will tell you that their rate of mortality is only about 17 per 1,000, and the average rate for the whole of London is 22 to 25. The Peabody Buildings cannot be very unhealthy if the mortality is only 17 per 1,000, and therefore I should like to know what is meant by overcrowding. Again, Dr. Thorne said, "Considering the evils that arise from overcrowding, do let us have open spaces to every dwelling." In the blocks of buildings erected by the same trustees, there are a great number of separate dwellings, and I believe there is not a single piece of open area throughout the whole, much less is there one for each dwelling, and yet in these dwellings, where there are 1,500 to the acre and no open areas, the rate of mortality is only 17 per 1,000. My observation in the Paper with regard to damp-courses has been misconceived. The Model By-law (17) specifies that in every case there shall be a damp-course 6 inches above the level of the ground adjoining the building. Upon that you are to put your ground-floor joists and have your floor on the top of them. Now, I ask you, when you go into Regent Street, to look and see how many shop-floors are 14, 15 or 18 inches above the level of the street. The great majority of them are on a level with the street. Somebody said at the last meeting there might be an area instead. I am quite willing there should be an area, but then why make a damp-course compulsory? The damp-course at 6 inches above the level and a wooden floor on the top of that necessitates the shop-floor being 18 inches above the level of the street. Go and ask any of the shopkeepers whether they would think of having that, and how much rent they would think of giving for such a shop. Then the Model By-law is framed upon the supposition that the ground-floor is the lowest wooden floor in the building. We all know there are wooden floors in the basement, and if the damp rises above the wooden floor it will do as much injury there as it will to a wooden floor above the level of the street. Therefore, do not tie people down to using any particular kind of damp-course. Let them use horizontal or vertical damp-courses as they think fit, or any other precaution that is necessary, but make it compulsory that they shall do that which will prevent the damp from rising. Use general language and enforce the provisions embodied in that general language. Mr. Gordon Smith said I had misconceived the By-laws, which refer to new buildings only. There is given a clause from the Public Health Act in the By-laws (page 5, sec. 159 of the Public Health Act, 1875), which reads as follows:—

"For the purposes of this Act, the re-erecting of any building pulled down to or below the ground-floor, or of any frame building of which only the framework is left down to the ground-floor, or the conversion into a dwelling-house of any building not originally constructed for human habitation, or the conversion into more than one dwelling-house of a building originally constructed as one dwelling-house only, shall be considered the erection of a new building."

If any building is so damaged by fire as to render it necessary to take it down to the

ground-floor, it becomes a new building and must be erected in conformity with the by-laws of the local authority. If it is not big enough for a man's business, and he throws two or three premises into one, then it is a new building. If any gentleman will read my Paper carefully he will see my remarks with regard to the application of the By-laws. When you are going to lay-out the increments of a town or a new town altogether, you have more scope and freedom of action, and you can enforce more stringent regulations than you can when rebuilding property in the heart of a large city or town, where land becomes so valuable as to sell for perhaps £250 per square yard. It is then a serious matter to insist upon an open area. Instead of dwelling further upon details, I will rather do what I can to enforce the desirableness of applying for a general Act of Parliament, which shall deal with essentials only. I am satisfied that if we go into details we shall never come to any agreement even amongst ourselves, and if we do not agree amongst ourselves, what weight shall we have with the Legislature? This evening there has been sufficient diversity of opinion expressed to show that, if you come to any particular point of detail, you will have architects differing as lawyers and doctors differ. There are perhaps scarcely two architects in this room who, if they were employed on the same building, would execute it in its entirety with the same details in every part. The question is this—What is essential to the public good? There are three objects which the Local Government Board have laid down as essential—stability of the structure, security against fire, and salubrity. What is necessary to secure those three conditions a general Act of Parliament should embody, and, according to my view, nothing more; and so far from allowing local authorities to frame additional by-laws, that would only be reviving and perpetuating the present difficulty. We should have the same diversity of by-law as exists at the present time. The general Act should be framed in language as general as possible to be effective; and let the Act be consistently and uniformly enforced. Such laws have been and can be enforced, and for my part I would say avoid details altogether. I have given a great deal of attention to this subject during the course of my professional career. Our profession, and I will celebrate our jubilee this year. At first I considered the Act of Parliament should be as like a specification as possible. Twenty years ago I was member of a Local Board, and being conversant with the subject my colleagues deputed to me the drawing-up of a code of By-laws, and if you saw them you would say—they are stringent and go very much into detail. But further experience has satisfied me that an Act of Parliament to be really efficient is not to be an educational measure, such as Dr. Thorne imagines, but is to be a statute couched in plain general language, and enforced in its integrity on all suitable and proper occasions. I beg to thank you for the kind reception given to me and my Paper, and I only wish there was a better prospect of our carrying a General Act of Parliament, but I am afraid some of us will not be here when a General Act of Parliament is obtained, and that those who are now young men will probably be very grey before the Legislature will pass such an Act as I think is desirable.

APPENDIX D.

SOME ANOMALIES IN THE ADMINISTRATION OF THE SANITARY LAWS.*

By Mr. E. B. ELLICE-CLARK, M.Inst.C.E.

Thirty years' experience of what were practically novel laws for England and Englishmen, has demonstrated the fact that the public in the aggregate take but slight interest in the administration of the sanitary laws—an apathy in itself so remarkable as to call for inquiry and discussion. In the selection of local representatives, where the election is made by voting papers delivered at the house of the voter, a very high percentage of such papers are never filled-in at all, and a large quantity only partially so. In selection by polling—where some of the rough excitement of a Parliamentary contest is thrown into the election, a little interest, if not enthusiasm, is exhibited; though curiously enough, not in the qualifications of the candidate to fill an office exclusively municipal and sanitary, but in the fact of his being attached to this or that section of politics. To such an extent has the mischievous practice grown that the political party to which the selected and rejected candidates belong has become a regular item in the newspaper reports of Municipal Elections, and the letters C or L are bracketed after the names of the New Mayors as though they formed an essential part of the official title. Why this want of interest on the one part, and misdirected interest on the other, is shown it is difficult to understand, and admits but one interpretation, viz.: ignorance of its importance. There is no question in which the public are so vitally concerned as the administration of the public hygiene laws, inasmuch as they affect all classes alike financially, physically and morally. Any demonstration which attracts the attention of the public to sanitary matters is therefore of great value . . . .

From an experience of sixteen years in various parts of the country, I am of opinion that one representative to every 3,000 inhabitants is plenty, with a minimum of seven, and a maximum of forty members, the latter adequate in itself to govern any town in Great Britain but the Metropolis. A large number of members always impairs the business capacity of a committee, though every class in every ward should be represented. Again, the area of elections is anomalous: in many towns, where the municipal area is undivided, at each election every voter exercises his influence over the whole town, instead of confining it to the particular quarter in which he resides—consequently we see one class and one interest only governing a town. The division of all sanitary areas into wards is so practical and just, that it should form the subject of a clause in the next Public Health Bill. The class of members is an important factor in the success or otherwise of the sanitary laws; in the large towns, doubtless, candidates with the necessary qualifications are attracted, though it cannot be denied that often the reverse is the case. A noticeable feature is the almost entire absence of the medical profession. Brighton, with fifty councillors, has not a single medical man on the Board. Of all the learned professions whose members would be of the highest value to a Sanitary Board, the medical is conspicuous by its absence. It is therefore desirable to attract, if possible, members of this profession. If, therefore, municipal electors would look more to the special qualification of candidates than to their party politics, and the numbers of the members were limited, greater efficiency and economy would result to ratepayers. The assimilation of the Sanitary Laws is much needed. Boroughs with Quarter Sessions are exempt from the operations of the Highways Act, 1875; they may appoint their own auditors, and do a variety of things which Local Board districts may not. While the Public Health Act contemplated uniform laws for all towns, its provision for making by-laws and its permissive character have produced quite the contrary result. Not only are the laws of adjoining districts different, but in the same area two separate Sanitary Authorities administer the law. In Local Board districts the Poor Law Authorities are armed with sanitary powers, distinct, yet clashing with the powers of the Sanitary Authority. Two sets of officers go over the same ground, two legally constituted bodies exercise their powers in dealing with epidemics in the same area; both have power to isolate disease. Such a conflict of authority can have but one result—that of impairing the Acts they administer. Further, we find an authority, created for the special purpose of relieving the poor, having cast on it the administration of the Sanitary Acts—a duty which it is clearly unable to perform in a satisfactory manner, more especially since the introduction of complicated regulations for new buildings. Is not the relief of the poor a question itself of sufficient importance to demand a separate authority? For by what process of reasoning are linked together such questions as out-door relief and the disposal of sewage? The areas of numerous Rural Sanitary Authorities contain large towns requiring urban supervision, the Union Authority is cumbersome, inconvenient, and unsuited to their requirements, while the multiplication of separate authorities would be equally so; a

* From a Paper read, 14th December, 1881, at the Brighton Health Congress, and published in the Report of that Congress.

redistribution of areas is necessary in such cases. County or Watershed Boards appear to offer the most practicable machinery for giving effect to Rural Sanitary Legislation. Of the division of great towns into separate authorities, the writer must speak with caution at a Brighton Congress; but putting aside local prejudices, the subdivision of a great town into districts has considerable advantages. Paris is so dealt-with, though under one chief. Nearly every great town in the kingdom is so divided—there may be cited Liverpool, Bootle and West Derby, Manchester and Salford, Plymouth and Devonport, with many others, in addition to Brighton and Hove. Whatever theoretical disadvantages this dual government possesses, it has this one practical advantage which must not be lost sight of—that it brings about competition. A standard of sanitary efficiency is set up at a standard cost; without a subdivision of authorities, there is not such a standard of efficiency at a given cost. Amongst the most important functions of a sanitary authority is the control of new streets and buildings—it may be here remarked *en passant* that a grave defect of the Sanitary Acts is the non-interference with existing buildings: remembering that the very nature of old streets and buildings was the primary cause of sanitary legislation, it would seem temporizing with the case not to deal with streets and buildings where sanitary evils exist. Property has justly great rights; but property has justly great obligations. To cite an example showing the deficiency of the Public Health Act. Any house erected previous to the adoption of the Act by the Local Authority may be enlarged, or dealt-with in such a manner as its owner wishes—it may be rebuilt with every sanitary defect, except bad drainage, perpetuated—there may be rooms of any height—without any ventilation, walls of any thickness, every inch of area within the curtilage may be covered—in short, all those evils for which by-laws are made may remain, and worse still, may be exaggerated and intensified, for there is no difficulty in so rebuilding a house as to place it outside the pale of the Act of 1875. Supposing that the application of every clause of the Building By-Laws would entail great hardship and deteriorate the value of property, is it not practicable to deal with the cardinal points of sanitation—rooms to be of a minimum height, walls of a standard thickness, air-space of a minimum area, where such area was previously not built on, waterclosets or privies to be erected next to an external wall, and have external ventilation. Respecting laws to control new streets, putting aside for one moment the anomalies existing in the requirements of different localities, a most important omission is the inability to control the direction of streets—convenience is of as great importance as construction, yet a property owner may so lay-out new streets as to render inconvenient for all time streets which in a few years pass into highways, usable and repairable by the public purse, entailing great sacrifice in carriage of burdens on succeeding generations. Few towns show this in relief to the extent of Brighton and Hove, where new streets from east to west have become an absolute necessity. These might have been arranged with immediate advantage to landowners, and perpetual positive convenience to the public, at little or no cost. They can now be only attained by sacrificing property, at great cost to the public rates. If the public are to bear the burden of maintaining in perpetuity any road, they have a right to determine its direction. The requirements of Sanitary Laws as to the minimum width of streets in Liverpool and the Metropolis is 20 feet; in Brighton 40 feet; many towns in Lancashire and Yorkshire insist on streets back and front, 35 feet as a minimum for front streets, 20 feet for back streets. What physical or other reasons exist for these variations? On the question of Mews, which may be any length and contain any number of human habitations, both the statute and all by-laws are silent. In practice we find them constructed on the old lines "of each to his own choice." Under the latest edition of the Model By-Laws there are erected Mews of great length, unrestricted in width, with dense populations, residing at the double disadvantage of living over stables surrounded with manure heaps, in confined streets. If, for the purposes of preventing overcrowding any area in a town, it is essential to have streets 40 feet in width, when houses are free from the insanitary contamination of stables, it would appear doubly necessary to give houses so situated an equally-large breathing area in front. Not only is the construction of such places insanitary, but positively unjust. If an owner of property proposes to construct houses without stables he must give a large area for street purposes; if he makes provision for both man and beast, then his own will is law, and he may crowd double the number of human habitations on a given area. A statute law enforcing a minimum width of front street when human habitations are erected is necessary. The sanitary supervision of new dwellings is a matter which requires much consideration and detailed labour before it can be effectual. Of all the various privileges interfered-with by the Sanitary Acts none strike so directly as the sections which relate to this subject. But, wide as their scope appears to be, and detailed as are provisions of modern by-laws, they are insufficient to effect the object intended. The first question arising on the 157th section of the Act of 1875, which empowers local authorities to make by-laws, is whether or not this section should be swept away and replaced by a Building Act as in the Metropolis, so that sanitary law would be Imperial instead of local. A great disadvantage possessed by by-laws is the difference existing between them in the same

neighbourhood. In one town of 4,000 inhabitants, within the writer's knowledge, there are four distinct sets of by-laws for new streets and buildings, administered by the same executive. Within two miles of these buildings (the Pavilion) there are three separate and distinct sets of by-laws, with this anomaly, that in the rural district the by-laws are more exacting and presumably more effective. . . . . It would not be difficult to frame a statute law for—(*a*) The width of streets, (*b*) Structure of walls, (*c*) Sufficiency of air-space, (*d*) Drainage of buildings; and other matters might be left to be dealt with under by-laws, remembering always that such by-laws should be as similar as is possibly practicable, allowing for the different physical conditions, and nothing further. No sanitary requirements that the necessities of the case demand should be omitted because of the value of the land, building materials, or the social position of the inhabitants. But while this change from by-laws to statute-laws may take years, new streets and buildings are growing with giant strides. In the Local Board district of West Ham 200 a month are completed; a public statement was recently made that the Tottenham Board had passed plans for 5,000 houses in one year. To imagine that all these houses are built in accordance with sanitary lights, even if the strictest by-laws are in force, is a delusion that should be exposed to the public as soon as possible. Mr. Lewis Angell, the surveyor of West Ham, in a recent paper says, "probably hundreds of thousands of houses are annually put together, we cannot say built, in such a manner as to be dangerous to the lives of the occupants. Not only is stability disregarded, but every essential principle of sanitation ignored. This result is as much due to ignorance as to carelessness. In too many instances it is also the result of the most wilful and wicked cupidity." Here is a public statement by an official of thirty years' practical experience. He makes no blush at telling the public that it is impossible for him and his staff to exercise anything like the most elemental supervision required; that this is generally the case throughout the kingdom is unquestionable. Sanitary authorities may not confess it in public; but those who see what is daily going on know that the most insanitary evils are being perpetuated, and modern speculating builders are forging a rod for the backs of our immediate descendants, which must kill its thousands and tens of thousands. You will ask as members of that public having to live in these houses: but what are the Sanitary Authorities doing? Is sanitary legislation a sham, and for what purpose have we a highly-paid official, whose duty it is to see the by-laws for new streets carried into operation? These are questions which naturally force themselves from the lips of the uninitiated. Let us look for an answer. The Local Government Board have recently issued a set of by-laws to be observed in the construction of buildings. Now, without entering into the details of those by-laws here, it may be broadly stated that, carried out in a liberal spirit, they would work an immense amount of good; they would put a stop to the erection of houses that are the veriest wigwams and more insanitary than the huts of the Kaffir. But how are they to be administered? Take the case of West Ham, with its 2,300 new houses a year. To execute the Model By-laws, there are fifty-two pages of closely printed matter, contained in ninety-nine by-laws to be observed, enough and to spare for any surveyor to have at his finger ends, and yet under these a house may be built without doors, floors or windows, or restrictions as to the height of rooms, nor is there one word about plumbing. When the building surveyor enters the carcase of the house there are more than one hundred and thirty distinct provisions that the builder must have observed. Let us pause here before we proceed to discuss the other works necessary to make a house fit for occupation. Presuming that each house is visited only once a month, then 26,000 distinct operations must be observed and noted by the inspector; but once a month is insufficient. . . . . I am of opinion that every house ought to be daily visited. To properly supervize a district having houses completed at the rate of 200 a month, at least six inspectors are required. They must be men of some technical education, and sufficiently well paid to keep them above temptation. This would entail a cost on the rates of, probably, £1,200 a year. This in itself is a heavy charge on the rates, which a Sanitary Authority would resent; indeed, few surveyors would venture to ask for such an increase of staff, nor does it appear that it is a fair charge on the rates. Sanitary companies are offering to inspect houses for a guinea per annum. Very recently such an association has been formed in Brighton. It has been very pertinently remarked that not for one guinea per annum, but for one guinea the sanitary authority could and would exercise such a supervision over new buildings as would satisfy all practical requirements. . . . Why should not the builder pay as he does in the Metropolis? One guinea would not add much to the capital sum expended on a house, nor would it exact much in the way of interest-rent. In Eastbourne and in London these fees are chargeable, and the ratepayers are recouped for their outlay by those persons whose works require supervision. Let such fees be paid for an efficient staff, to be provided in all towns, and it will be found that a great work has been done which now remains to be accomplished.

VIII. THE WORKS OF THE LATE WILLIAM BURGES, A.R.A., *Fellow*.

By R. P. Pullan, *Fellow*.

[Read on Monday, 17th April 1882, Horace Jones, *Vice-President*, in the Chair.]

IT may be safely asserted that it is but seldom that any great artist attains the full measure of his fame or receives his due tribute of praise during his life-time. The jarring and jostling events and interests of every-day life, the jealousy with which the career of every superior man is regarded, together with the fact that he must occasionally be overtopped and overshadowed by his rivals and competitors in the race for distinction, prevent our obtaining a clear view of the artist and his works while he is among us. It is only when he has disappeared from the scene that, by calmly reviewing his life and works, by remarking the effect they have had upon his generation, by weighing his excellencies and imperfections, by noting the obstacles he had to contend-with, and how he triumphed over them, we are able to sum-up the full amount of his merit, and thereby assign him his proper niche in the temple of Fame.

If this be true of artists generally, it is especially so with regard to architects, for their works appeal less to the senses and more to the intellect than those of painters and sculptors, and it requires the study of years to comprehend them perfectly in all their details. Hence, though an architect may live to a ripe old age and be a proficient in his art, it is seldom that he is appraised to the full extent of his value while he lives, and unfortunately, as we know by sad experience, many of the most eminent of our brethren have been cut off in their prime. The fact then that the fame of the architect must be to a certain extent posthumous makes it desirable that, when a fellow-member of any eminence dies, his life and works should be put before you in order that you may form a true estimate of his merits.

Burges, by many years of patient labour to which his numerous volumes of sketches bear witness, had made himself thoroughly conversant with the principles and mastered the details of the peculiar style which he affected. It requires special knowledge to perceive their "*motif*" and to recognize the sources from which they were derived. Thus, though his capability as a designer was acknowledged by many, there were but few who were qualified to form a just conception of his works, to enter fully into their spirit, and to see in him the first art-architect of his day in his own particular line. That he was such I hope to convince you with the aid of the collection of his works exhibited, pointing out the strong points of his designs, so that by comparing his works with those of his contemporaries, you may come to the same conclusion as myself,—that he was pre-eminent in every branch of his art. Before commencing the somewhat dry and technical description of his numerous designs, I must say a few words about his personal character and disposition, his training and his surroundings, for all these things undoubtedly give a tone and colouring to the productions of any artist. Burges was emphatically what Mr. Beresford Hope calls him—"noble hearted."* His generosity was manifested not only in the lavish manner in which he presented drawings of his various works to his intimate friends, but in the liberal way in which he imparted

* See the Proceedings, 1881-82, page 98.

information on his favourite arts, which he had acquired with great labour, to his fellows. His mission he conceived was to teach, and by many lectures, by papers on various art subjects, and by instruction given not only to his pupils but to anyone who applied to him, he helped greatly to extend the appreciation of gothic architecture; by personal superintendence of workmen in all branches he, so to speak, formed a school of artists and artizans who imbibed in some degree the spirit of their friend and employer or master.

Another even more valuable trait in the character of Burges was his conscientiousness in all things appertaining to his profession. He never would undertake a work that he felt he could not carry-out thoroughly; hence all that he undertook was well done. He spared no pains nor labour to reach perfection. Fortunately for posterity he had no need to make money quickly, and therefore there was no necessity for him to build by the acre. He had not the extensive practice that some have, but he had leisure to perfect all his work. Cork Cathedral was commenced about 1863 and is not yet quite finished; Cardiff Castle in 1865, and that is still incomplete.

Two or three other traits I may mention, for, although they may seem to some at first sight trifling, they had considerable influence upon his rendering of his art: I mean his singular boyishness and playfulness of disposition, his remarkable fondness for animals, and his affection for the comic element and appreciation of the grotesque. In all his decorative designs you will see a multitude of birds, beasts and fishes. The walls of his chambers and house are covered with them. Comic pictures of Æsop's Fables, the signs of the zodiac dancing a break-down, the caricatures on his bookcases, are all evidences of his love of the comic element. He delighted in reproducing the monsters half-beast and half-man that one sees in the sculpture of mediæval times—on the portals of Rouen Cathedral for example. In dogs he delighted, and he had generally two or three at his chambers, and, if we may believe what some people say, to the injury of his practice. One of his cabinets is covered with the portraits of these dogs. The parrot was his favourite bird on account of its grotesque motions, its fine colouring and its great intelligence. His favourite parrot stood by his bedside until the day of his death, and several windows in his house are adorned with pictures of this bird of resplendent plumage. Thus it is evident that even such a minor trait in his character had considerable influence upon his work; in fine, he was a generous, kind-hearted man, and a conscientious architect. He was somewhat too outspoken to be beloved by the ignorant and self-conceited; but the crowds of warm-hearted friends assembled at his funeral show that he was appreciated, and what is more—really loved. He was a learned archæologist, and he brought all his learning to bear upon his work. He was an incessant but not a desultory reader. His chief studies were history, mediæval romances, inventories, old household accounts, &c., and he very seldom took up a book that did not in some way turn upon the history of architecture or the minor arts. He was the best iconographer of his day, and so fond of imagery that his complete works are embodied poems so to speak, which it requires more than a tolerable acquaintance with mediæval literature to comprehend. The minor arts—such as sculpture, decorative painting, glass painting, jewellery, art furniture—were at his finger ends, in fact, the designs which he made for such works absorbed almost too much of his time.

Now as posterity will judge a man not solely by his executed works but by the character of his designs, it is well to take into account, in order to render him his fair meed of praise,

not only the work he carried-out, but the designs he prepared and matured, and which, either through want of knowledge on the part of the judges or on account of his own temperament, which prevented him from being as supple as committees and clients desired, have not been executed. Take for instance his design for the Memorial Church at Constantinople. The plan was a parallelogram, 140 ft. by 70 ft., terminating in a semi-circular apse. The nave was 25 ft. wide, there were three bays covered with hexapartite vaults; the two bays to the west were sub-divided by smaller coupled columns, and that to the east formed a sort of transept. The columns were circular, and above them were vaulting shafts. The triforium consisted of three arches, the centre only being open. The clerestory had windows of single lights, with geometrical tracery in their heads. The transepts had wheel windows. Three deeply recessed doors, with a lean-to roof over, gave great effect of light and shade to the west end. Massive square buttresses without weather tables, and crowned by pyramidal pinacles covered with parti-coloured tiles, marked the divisions of the bays. The whole church had an Italian character about it, and was, to a certain extent, taken from the church of St. Andrea, at Vercelli, which was supposed to have been built by an Englishman. Burges paid a visit to Vercelli especially for the purpose of studying the church. The building would have been polychromatic, constructed as it was intended to be with stripes and columns of red and grey marble. The original design was found to be too costly, and not less than three sets of plans were subsequently made to reduce the cost, yet notwithstanding this, and although Burges went to Constantinople to assist in laying the foundation-stone, the building was eventually given to Mr. Street. This was partly Burges's own fault, as his singular independence of character prevented him from making an entirely fresh design to suit the wishes of the committee; he considered his design the best suited to the site, and consequently refused entirely to re-model it or to do away with the stone groining throughout, which was a considerable item in the estimate. He subsequently came to the conclusion that stone vaulting was not a *sine quâ non* in a thirteenth-century church, and in all his subsequent designs used wooden ceilings.*

I have heard many competent judges express regret that his grand design for the Law Courts was not carried-out. The immense tower, perhaps, was out of scale, and the circular turrets were, perhaps, too symbolical of the military character of the processes carried-on in the building, but the rest of the design was characterized by extreme beauty, and to have carried-out the design in all its ornamental details would have been to Burges a labour of love, while to his generation the result would have been, I think, a cause for jubilation.†

Within the last two or three years I have had an opportunity of inspecting the rival designs for the reconstruction of the western façade of Santa Maria dei Fiori at Florence, and have come to the conclusion that Burges's design would have been a more thorough realization of the views of the mediæval architect than that of any other competitor, and in one point especially. There are three circular windows in the front façade, plain, and filled with stained

* Burges's visit to Constantinople was, however, not without happy results, for he then perceived that there was a certain accordance between the forms and colours of Eastern and Gothic architecture which led him in a spirit of enlightened eclecticism to unite these forms and colours in some of his most happy productions, as for instance, in parts of Cardiff Castle, and of his own house.—R. P. P.

† See note at page 199 respecting Burges's opinion on the proper style of architecture for the Law Courts.

glass; they correspond with others in the clerestory. Burges proposed to leave them plain, as in the original design; at present it is contemplated to fill them with elaborate tracery, which will greatly injure the effect of the stained glass by throwing shadows upon it.

Although Cork Cathedral is the most complete specimen of ecclesiastical architecture carried-out by Burges, it yields the palm, as far as grandeur of effect and beauty of proportion are concerned, to the design submitted in competition for the Cathedral of St. Mary, Edinburgh. The design was for a noble church 202 feet in length, with a width of 62 feet, including aisles. Two towers with wooden spires, 200 feet high, are placed at the west end, and a high *flèche* at the intersection of nave and transepts. The apse, like that at Cork, is semi-circular, but gains in effect on account of the wider bay between transepts and the commencement of the semi-circle. Internally, the treatment is somewhat similar to that of Cork. There are six bays in nave, cylindrical columns with detached shafts, those towards the nave running up to support the tie-beams; equilateral arches, triforia of three arcades and two bold lancets in the clerestory. The aisles have two-light windows with foliated circles in the heads, the transepts have a bold wheel-window above four lancets. The chancel has three bays, double arcades in the triforium, and single lights in the clerestory; the arches of the main arcade are all stilted. Externally there are two lancets in each bay covered with crocketed pediments, and between every two windows figures of angels. At the west end were three fine portals with sculptured tympana, a triplet in the centre. In my opinion this was incomparably the most artistic and picturesque of the designs submitted, but it did not gain the victory, as it seems that the committee of judges preferred British to French architecture. The ceiling throughout was to have been boarded, as at Cork.

His first work of any importance was a cathedral at Brisbane, N. S. Wales. The total internal length of this building, which had nave, aisles, transepts and three semi-circular apses at the east end, is 172 feet by a breadth of 62 feet. The nave is 98 feet in length, and has six bays and circular columns, the clerestory windows are circular and foliated—internally a double lancet with a column in front of the centre of the circle forms a sort of screen—the columns rise from a string above the nave aisles, and each arcade is divided by a low column supporting a string mould so as to form a sort of triforium; the same arrangement is carried through the chancel, which has no aisles. The chapels alone are groined, the roof of the main building being arched and boarded. The external proportions are not so pleasing as those of the interior, on account of the great width of the bays, both of the aisles and clerestory, with reference to their height. The east and west ends are good compositions. At the east end there are two rows of two-light windows, with cusped arches in their heads, separated by massive buttresses of four stages. At the west end is a wide arched doorway divided in the centre by a *trumeau;* above are four lancets of unequal heights and a large rose window, all included in a bold arched recess; an arcade runs beneath the windows. I am not here to criticize, but to describe, Burges's work, yet I cannot but confess that this is the least satisfactory of his ecclesiastical designs, as it is of somewhat squat proportions, and the tower with a gabled roof is undoubtedly heavy.

It is much to be regretted, in my opinion, that Burges was not more extensively employed in restorations, as his learning and research combined with his conservative instincts

fitted him especially for this sort of work. Waltham Abbey was his chief restoration. This fine old Norman nave—the transept and choir had been destroyed ages ago—was fast falling into ruin, and the massive columns were cracked through in various places; these he underpinned, and he bound the old walls with iron. As funds did not admit of a rebuilding of the choir, he erected an eastern wall, in the Transition style between Norman and Early-Pointed, employing very vigorous mouldings in order that the new work might partake of the massiveness of the Norman. Above three lancets supported by sturdy columns he placed a bold rose window; below the lancets was an enriched string, and under this he designed a reredos, full of sculptures of the early life of our Lord. This was painted and gilt, and is one of the most beautiful of his works; it was modelled and carved by Mr. Nicholls, who has in all his works thoroughly imbibed, so to speak, the spirit of the designer. The ceiling is flat, painted in compartments like that of Peterborough. Subsequently the Lady Chapel, the windows of which were blocked-up, was thoroughly restored, and the tracery replaced.

The Cathedral of St. Finbarre, Cork, is undoubtedly Burges's greatest work in ecclesiastical architecture. It has a semi-circular apse, shallow transepts, a central tower and spire, and two towers also with spires at the west end. The nave has six bays,—the westernmost and easternmost being rather narrower than the rest in order the better to resist thrust from the towers. The columns are plain cylinders with small shafts attached on the face towards the nave, to support the tie-beams of the roof. The arches are equilateral; there are two lancet arches in the triforium, and a plain lancet window in the clerestory. The transepts have wheelwindows above four lancets. The chancel has but one bay before the sweep of the apse begins; this and the adjoining bays are narrow with single lancets in both triforium and clerestory. The columns of the choir are coupled. The ceiling both of chancel and choir is boarded, and will eventually be richly decorated with colour.

The exterior is simple, with the exception of the west front, where there are three of the richest portals executed in modern times. The central arch has five recessed orders of mouldings; below these there are the five wise and five foolish virgins with the bridegroom in front of the pier which divides the archway into two doorways, and which the French call *trumeau*, but for which we have no equivalent in English In the tympanum is a representation of the Last Judgment. The two side doorways have figures of the Apostles. In the north-west tympanum, the Fall, and the Expulsion from Paradise; in that on the south-west, the Dedication of the Temple of Solomon, and the Entombment. The stained glass windows, which are almost all completed, represent in the nave subjects from the Old Testament; in the choir, subjects from the New Testament. The rose window in the south transept has the heavenly hierachy, that in the north the Resurrection; the clerestory of the choir has full length figures of patriarchs, prophets, evangelists and apostles, and that of the nave the signs of the zodiac.

The Bishop's throne is a high canopied structure, reaching to the arches of the triforium. The sedilia consist of three canopied seats with angels playing upon musical instruments. The stalls are without canopies, but are richly adorned with carvings of animals, fruit and foliage. The mosaic pavement of the choir is founded on the text, "Again the Kingdom of Heaven is like unto a net that was cast into the sea, and gathered of every kind,"—the net is

represented as attached to corks, and the waves of the sea are symbolized by the graceful curve used by the Greek artists for that purpose; within the meshes of the net are men of all kinds—the doctor, hunter, soldier, rustic, fisherman, merchant, husbandman, artizan and child. In front, in a border are shown the Parable of the Mustard Seed with the Sower, and the Good Shepherd seeking the Sheep that was lost. The font and pulpit are circular in plan supported on stunted columns of rich marbles. The lectern is brass, of very massive character The decoration of the choir roof is to consist of angels with musical instruments; that of the nave, of figures representing the virtues, Faith, Prudence, Valour, Fortitude, &c., in hexagonal compartments. Altogether the cathedral is a unique example of a building carried-out to its most minute details in one style—the French of the 13th century—and is well worthy of careful study. Fortunately Burges's talent was appreciated thoroughly at Cork, and the bishop, dean and the committee, enabled him to exhibit to the fullest his power of design. The result is a building in which there is more unity of design than in any other of similar character in the United Kingdom.

Of smaller dimensions, but carried-out in the same thorough manner, were two churches in Yorkshire, one built for the Marquis of Ripon at Studley, and the other for Lady Mary Vyner at Skelton, which are both model parish churches. The dimensions of these buildings are similar, Studley having a nave 60 feet in internal length, by a total width of 40 feet including the aisles, and a chancel 36 feet deep. At Skelton the respective measurements are, nave 64 feet, chancel 33 feet. They are both in the Geometrical decorated style. They have both four bays, triforia and clerestory; the tower at Studley is at the west end, and at Skelton at the north-east angle of the nave. It will not be necessary to describe these at length, but sufficiently to notice the peculiar features which give them originality. Extreme lightness and beauty with great play of light and shade is obtained in the chancels of these churches by the employment of a double set of tracery to the windows—of an internal screen, it may be called, with passage between. This screen exists at the west window of Studley, where it is enriched by foliage in high relief representing a genealogical tree. Another original feature is the ceiling of the chancel,—that part over the eastern bay or sacrarium being raised in the form of a dome covered with tracery, in the panels of which there are angels painted, playing on musical instruments. The east wall of the exterior of Studley is a fine composition; above a rich geometrical window of five lights there are panels filled with sculpture of the Crucifixion. At Skelton the principal group of sculpture is on the east wall of the nave, over the chancel arch, the subject being the Ascension; the apostles are in arcades, and the figure of Our Lord is in a vesica above. The furniture and decoration of these churches are, so to speak, perfect. Pavements were always Burges's strong point; at Studley in the chancel there are representations of the sacred edifices of Jerusalem, the Holy Sepulchre, Golgotha, Gethsemane, the Church of the Resurrection, the Golden Gate, the Temple, and the Tomb of David. The pavement of the sacrarium at Skelton represents the Garden of Eden symbolized by flowers of various kinds in compartments, bounded by the four rivers Gihon, Pison, Tigris, and Euphrates, flowing from vases held by four figures at the angles; in the centre of the front there is an angel seated guarding the Gate of Paradise. The stained glass throughout is appropriate; the east window has the Crucifixion, above and below Sacrifice represented by the sacrifices of Noah, Manoah, Abel, Abraham, &c. In the nave events from the Old and New

Testaments with their antetypes. Similar stained glass was employed at Skelton, but these two churches of the same period are treated in a totally distinct manner.

In addition to these, many designs for village churches were prepared by him, such as Fleet Church, a small brick building with square piers in place of circular columns, and lancet windows. This church contains a beautiful tomb to the memory of the wife of the founder, Colonel Lefroy. Temple Brady, near Cork, is a simple nave without aisles, with Early-Pointed windows, and a detached round bell tower, resembling the Irish round towers which exist at Glendalough and other places. The tower has a series of arcades at the top and a conical roof. An Hibernian writer calls the building " Early Celtic," racy to the soil, and in pleasing harmony with the surrounding scenery. Bewholme, with a west porch and tower at north-west angle of nave, and several others were built from his designs.

The Marquis of Bute, whose enlightened taste and archæological knowledge led him to be one of the first to recognize similar qualities in Burges, employed him in the year 1865 to report upon Cardiff Castle, with a view to its complete restoration. Burges drew up a masterly report on the state of the castle, which consisted of an inclosure measuring several hundred feet square, bounded by walls 30 ft. high. Near one angle of this inclosure were the remains of a polygonal keep, but that part of the castle which was occupied as a residence stood near the S.W. angle of the inclosure. It consisted of chambers of various dates from the thirteenth to the eighteenth centuries. According to Burges's usual careful system of proceeding, he visited the castles at Conway and Caerphilly, and examined them for precedent. In his report he recommended a course which was chiefly conservative. The wall towards the town he proposed to crown with embattlements, and a covered way like that used to protect the archers of old; and at the S.W. angle he proposed to erect a stately tower. The buildings that were external to the castle wall, he said, should be swept away. The Marquis of Bute authorized the report to be carried-out with the greatest liberality. The clock tower, which is well known from various representations, was carried up to the height of 150 ft. As it communicates with the main building only by means of a passage on the wall, the rooms in it could only be used as occasional rooms, such, for instance, as smoking-rooms.*

During the erection of the clock tower all external buildings were swept away, and the towers, called respectively Lord Bute's Tower and the Octagon Tower, exposed to view, and the intermediate wall was crowned by a bold embattlement. The buildings on the interior, which were subdivided into small apartments, were gutted; a square entrance hall and grand staircase, a large library on the ground floor, and noble hall on the first floor, were constructed in their place. The walls of the hall are adorned with paintings representing events from the life of the Empress Matilda; and the windows of both hall and library are filled with stained glass. The Octagon Tower, which was of Tudor times, was restored in that style, and surmounted by a high octagonal lantern and *flèche*, which form a conspicuous feature in a view of the castle from the south-west. Burges obtained a certain amount of regularity in his restoration by erecting a fourth tower, called the Herbert Tower, not yet quite finished. In this there is an Arab room, with honeycombed ceiling and stained glass, such as may be seen in the East. This and the use of various styles in the restoration prove that Burges was not so bigoted and wedded to the thirteenth-century style as some assert, but that though he was far removed

* A description of this clock tower will be found at page 21 *ante*.

from the eclectic school, he practized an enlightened eclecticism, and that, having seen in Sicily the wonderful result of the combination of Gothic and Arab forms and colouring, he did not hesitate to take advantage of them when he had the opportunity. It would take a whole evening to describe the decorations and furniture of this magnificent castle, upon which was lavished the greatest inventive power of the architect. In Cardiff, as at Cork, he had ample leisure to mature his designs, as the work has been going on for the last fourteen years, so that the amount of thought and study spent upon it exceeds that devoted to any of his other edifices.

It falls to the lot of but few architects in the present day to restore a mediæval castle in its entirety. Weak embattlements and sham machicolations by the yard are attached to signorial residences to suggest in some measure their original feudal character. But when it comes to the question of rebuilding keeps, with walls from ten to twelve feet thick and to a height of 100 feet, even the most enthusiastic archæologist, with an unlimited command of money, hesitates before he determines upon the outlay. Carcassonne and Pierrefonds, restored by Viollet-le-Duc for Napoleon III; and Castle Coch, restored by Burges for the Marquis of Bute, are the only mediæval fortresses, to the best of my belief, that have been restored almost in their original integrity. This most complete specimen of the military architecture of the twelfth and thirteenth centuries is due to the archæological knowledge of the Marquis, which enabled him to confide in Burges's antiquarian researches, which were manifested in a report upon Rothesay Castle, and also one upon the castle under consideration. High up on the side of a wooded hill, about five miles from Cardiff, stood the crumbling ruin of a castle which guarded the pass through which a river flows from the interior to join the sea at Cardiff. The building, which was thoroughly dismantled and an utter ruin, consisted of a courtyard, three round towers, and with what had been living-rooms between. A ditch ran round three sides of the walls, on the fourth there was a steep declivity, which rendered the ditch unnecessary. Burges rebuilt the walls to their original height, carried up the three towers to a height of about 100 feet at the highest point, covered them with conical roofs, and re-arranged the whole interior, so as to make it habitable, and as comfortable as it could be in consonance with strict adherence to style. You enter the courtyard by a drawbridge and through a wide gateway defended by a real portcullis—not one of those rows of pointed laths which Pugin so ridiculed in his "True Principles," as being attached to the doors of sham Gothic castles—but a genuine article composed of hard wood several inches thick, shod with iron spikes, and raised and lowered by machinery. I can imagine the construction of this portcullis—perhaps the only one of modern days—was quite after Burges's own heart, and that he would have spent upon its contrivance more time than many of his contemporaries would spend upon a design for a house. On the left, upon entering, are the keep tower and the kitchen tower, united by the hall. The former has on the ground floor a sitting-room; on the first floor an octagon drawing-room, with galleries in carved stone running round, and a handsome chimney-piece, with figures of the Fates. Above, there is a bedroom. A hall, 32 ft. by 20 ft., lighted by two-light windows with deep embrasures and stone seats, having an open wooden roof, adjoins the drawing-room on the same floor; it is furnished with massive tables and benches, and ornamented by large decorative paintings representing the life and martyrdom of British saints. Beyond the hall is the kitchen tower, with offices and servants' bedrooms, approached by an open staircase from the courtyard. The third or well tower has on its topmost floor a small chapel of wooden construction, partly

projecting on immense wooden brackets towards the courtyard, and forming a most picturesque object. The restoration was most conservative throughout, not a feature of the original building being altered nor even a stone unnecessarily displaced. In its entirety the grey walls and massive towers of Castle Coch, seen amidst the thick foliage which environs them, tend more than any other building of modern times to carry the mind back to the contemplation of the days of lawlessness, when every man's hand was against his neighbour and when the most valuable of habitations was a castle with walls of enormous thickness, and defended by a moat, drawbridge and portcullis.

The most important of Burges's public buildings, and one of the most extensive of modern days, is the College of Hartford, Connecticut, now in course of construction. It has a frontage of 1,020 ft. by a depth of 260 ft. This space is occupied by four quadrangles, each 200 ft. square. The first contains the professors' residences, the second a chapel, with a high tower and spire, the third a capacious hall and lecture-rooms, and the fourth students' residences. All the detail drawings for this immense range of buildings are prepared, and they afforded a large field for the author's ingenuity and for carrying-out the style he loved best. The grouping of the masses of building, with their high-pitched roofs, dormers, towers, *flèches* and turrets is picturesque in the extreme, and, when completed, will form a whole of which America may well be proud.

The Speech Room at Harrow required considerable ingenuity in the adaptation of Gothic architecture to a room in the form of a theatre; but it was successfully accomplished without the loss of any of the characteristic features of the style. The great difficulty in such a room is the immense expanse of ceiling, which he got over by using wooden groining over the seats, and covering the central part of the ceiling with panels.

It has been frequently said that Burges shone most in his domestic architecture, partly, I presume, because he has had more scope for the production of accessories in the way of furniture and fittings. I am not of this opinion myself, for I think that it would be difficult to name any modern church which possesses the same unity of design, correctness in style and completeness of decoration as Cork Cathedral. His realization of the mediæval house was, however, very complete, and as no thirteenth-century house exists with its fittings, it perhaps required more knowledge of style, and what may be called tramelled invention, to produce a house such as it might have been at that period, than to design a cathedral. Knightshayes, built for Sir John Amory, was his largest domestic structure; it has a frontage of about 150 feet, and is three storeys high. The hall, like that of an ancient house, has its screen, oriel, and an arched roof. Three pointed arches on round columns separate it from the staircase. All the rooms are wainscoted with teak wood, oak or ebonized wood, with paintings of flowers on the panels. The beams of the ceiling are visible throughout, and form, with the joists, panels enriched with paintings. This house, had the decoration been carried-out according to Burges's views, like his own residence at the Melbury Road, would have been an embodied poem. His system was to make all the paintings in each ceiling refer to some subject. Here, as at Melbury Road, love formed the subject for the painting of the drawing-room, fairy tales the morning-room; the history of St. George and the Dragon contributed to the adornment of the staircase, but we shall see this principle more thoroughly carried-out on considering his own house.

It was ever Burges's ambition to build himself a house in which he could indulge his taste for the beautiful to the utmost. I believe he had this in contemplation many years before he found himself able to accomplish his wishes, and that much of the furniture and plate that he designed while living in chambers was intended for his future abode. He secured an eligible site in 1874, when a portion of Holland Park was cut off and devoted to building purposes. After many preliminary studies he decided to build on the present plan, which I will describe in detail. A flight of eight steps leads to a porch, thence a bronze door ornamented with representations of the four ages of man, in panels, opens into a hall, and I may mention that the floor of the porch is inlaid with a mosaic representing his favourite poodle "Pinkie," like the *cave canem* of the Romans. The hall is open to the roof, and in it there are five doors with emblems over them, significant of their destination: over that of the drawing-room there are musical instruments; over that of the library, books; over that of the dining-room a flask of wine and plates; over that of the garden-door a rose, and over that of the entrance-door a latch key. The floor has a mosaic of the combat between Theseus and the Minotaur within a labyrinth. The walls are adorned with full-length figures of the morning and evening stars, and the roof is painted with red and grey panels, within which are birds, beasts and fishes. The light is obtained from a large window filled with stained glass, representing morning, noon, twilight and night, in the form of female figures issuing from bells. A gallery leading to the bedrooms occupies one side. The door leading to the garden is also of bronze, with figures of the Virgin and Child.

The drawing-room will be, when finished, the most complete in the house; it faces the north, and has three three-light windows, separated by piers of Devonshire marble, with arches above them, forming deep recesses. The walls will be covered with panelling painted green, and adorned with paintings of flowers; in the panelling there are four lockers, the doors of which have most highly finished emblems of the winds, the oceans, and also flowers with a fairy in each. The decoration of the room throughout relates to the tender passion of love. The chimney, which reaches the full height of the room, is an heroic representation from the *Roman de la Rose;* the hero is described as seeing the heads of the enemies of Love depicted upon the walls of the garden. These are shown in heads, in which the expressions are wonderfully rendered, immediately over the fireplace: such as Sadness, Envy, Poverty, Hypocrisy, &c.; and above, forming a sort of frieze, is depicted the garden of Love, shown by trees full of fruits and flowers, beneath which the friends of Love are disporting: such as Beauty, Wealth, Desire, &c. At one side the dreamer is entering the gate of the garden, admitted by Idleness, and on the other he is plucking the flowers and fruits; above all is a large robed mediæval Cupid, surrounded by love birds. The ceiling, which is divided into panels by beams, has pictures of Cupid under different forms. The stained glass windows contain heads of the "professional beauties" of antiquity, or rather of the women most celebrated for their beauty: Helen of Troy, Cleopatra, Galliana, and others. A deep painted frieze runs round the room, and on it are depicted love scenes taken from pagan and mediæval story: Hero and Leander, Ariadne and Theseus, Pyramis and Thisbe, Cupid and Psyche, Venus and Adonis, Francesca da Rimini, Lancelot and Guinevere; also the story of Circe turning the followers of Ulysses into swine. These various histories are treated as they would have been in the middle ages, that is to say, the heroes and heroines of classic times are robed in dresses of the thirteenth century; even Cupid wears a decent gaberdine, and Venus has a wimple.

I have heard objections to this mediæval rendering of classic subjects from a person of very good authority, who considered that they should have been nude, or clothed in dresses of Greek or Roman time, but I think that they are, as they exist, more in character with the house of the thirteenth century which Burges wished to realize.

The library has decorations appropriate to its use. The chimney-piece represents the dispersion of language at the time of the destruction of the tower of Babel: Nimrod sits enthroned on high, and beneath him Lady Grammar, issuing from a gateway, is sending the parts of speech through the world. First come the pronouns, two trumpeters; then the verb, a queen, whose train is held up by two pages, the articles; then comes the noun, a porter bearing a burden, that of the sentences, adjective and adverb; conjunction, two lovers arm in arm; and interjection, a man exclaiming oh! The ceiling has eight compartments, with portraits of the six founders of systems of law and policy: Moses, Mohammed, Aristotle, Justinian, St. Paul and Martin Luther. The windows show the Arts: architecture, painting, sculpture, navigation, agriculture, &c. The bookcases have on their doors a quaint alphabetical series of paintings, which illustrates the humour which characterized Burges: A is a caricature of himself, with a large pair of compasses in his hand, and a model of his house in the background; B, a builder with an uncommonly long bill, and so on through the alphabet.

The dining-room also contains an example of this playfulness in a frieze of tiles, a row of coloured figures on a white ground of the heroes and heroines of fairy tales, all in mediæval costume. The walls are lined with red marble. The ceiling has a highly-coloured design in enamelled iron of the sun, planets, signs of the zodiac, &c. The glass here refers to food: soup, vegetables, fish, &c.; soup is represented by a man with a turtle. A marble column and pointed arches separates the hall from the staircase, which is circular; it has a stained glass window, with the storming of the castle of love.

The guests' chamber is on the left hand. For the decoration of this chamber Burges borrowed from nature a frieze of flowers, and he covered the ceiling with butterflies. The morning light filters through glass like that in the East in small pieces, and the windows have those lattices which one sees in Damascus, Cairo, and Constantinople.

As in the guests' room, with its frieze of beautiful flowers treated rather in a naturalistic than in a conventional manner and its hundreds of fluttering butterflies on the ceiling, earth seems to have formed the *motif* of the design; so, in his own bedroom, the sea seems to have been the leading idea, as the scaly monsters of the deep glide in undulating lines symbolizing the sea, and forming the frieze. The place of honour in the centre of the chimney-piece is occupied by a fair mermaid with a mirror, throwing back her luxuriant locks, and on the frieze beneath skate and john-dory are seen disporting in the curling billows. The prevailing tone of the guests' room is gold; that of his own bedroom a deep red. The ceiling of the latter varies from the other ceilings of the house in being framed as semicircular beams, the intervening spaces being filled with stars, the centre of which are formed by mirrors.

The other rooms of the house are as yet incomplete. It would take too long to describe the furniture, which is all covered with appropriate paintings: one wardrobe has the misfortunes of literary men; another, representations of the different artificers of clothes, bootmaker, hatter, &c., offering their specimens of clothing to Adam and Eve, who stand in the midst robed in simple fig-leaves, and so forth. The whole house is an interesting study and

a poetical composition of no ordinary merit; it must be ever regarded by Burges's friends as a monument of his peculiar genius and painstaking care.

A house for Mr. M'Connochie, at Cardiff, is very similar in plan, but rather better in some respects, as it has an effective external instead of internal arcade to the drawing room, a central staircase and loftier rooms, but at present it is not decorated in the same style.

Although Burges had an especial affection for Gothic, the versatility of his genius enabled him to comprehend and to enter into the spirit of other styles. The decoration of the chapel and hall of Worcester College showed a thorough appreciation of the works of the early Italian masters in decoration. His scheme for St. Paul's, which included a most careful iconographical study, also exhibits this appreciation. This design has been much discussed and criticized. No doubt the proper mode of decorating St. Paul's would be to copy Thornhill's painting in coloured mosaics, and put similarly designed pictures in other parts of the church, but his severe taste led him to propose ornamentation like the Italian pre-Raphaelite masters, such, for instance, as the work of Perugino at the Sala del Cambio, Perugia, and other places. His design was certainly Italian mediæval, inasmuch as St. Paul's itself is a building which may be said to be in the Italian mediæval style. He designed a gallery for the Marquis of Northampton in the style of the Renaissance, and also executed a very effective staircase for Lord Carington at Gayhurst in a style bearing affinity to Renaissance.

Burges has left behind him volumes of sketches, which testify to his industry, but he has also left careful drawings, which are charming studies, showing how thoroughly he could throw himself into the spirit of mediæval times. One of these is a sketch for a fountain at Gloucester, no doubt familiar to most of you, illustrating the history of Sabrina, who stands in the middle of the picture; the background is a beautiful composition of Gothic buildings, with towers and spires of elegant design, and in the foreground, with his characteristic humour, he has represented the lock-up and the stocks. Another drawing of different character is a representation of St. Simeon Stylites on his column, as it might have been rendered in the fourteenth century, or even in the time of Albert Dürer. The saint, in the last stages of emaciation, is shown on his column, which rises over a series of Gothic buildings, which might have been adopted by a mediæval artist to symbolize the conventual buildings found by the Marquis de Vogüé in the Syrian desert.

I cannot conclude without a few remarks upon the chief characteristics of Burges's architecture. His comparison of ancient examples led him to adopt certain features of French Gothic, which are traceable in all his designs, for instance, the semi-circular apse, which is certainly the most appropriate and convenient termination for a cathedral. We find it in his Constantinople Church, in his Cathedrals of Brisbane, Cork and Edinburgh. The circular columns with the square abacus, sometimes enriched by detached shafts, we also find in all these edifices. The open pinnacles, which form the most pleasing feature in the cathedral of Laon, and which give indescribable lightness and elegance to the towers there, he adopted in the towers of Cork. The plain round moulding, which has always a bold and vigorous effect, was constantly employed by him; also the arched and boarded ceiling, of which there are examples in both France and Italy, at St. Zeno, Verona, and another church outside that city, he used at Brisbane, Cork and elsewhere, with and without tie-beams. The graceful central *flèche* was a favourite feature in his designs, of which he no doubt gained his appreciation

when making the careful measured drawings of that at Amiens, published in his book. Notwithstanding his severe taste as to correctness of style, he used, as I have before said, a certain degree of eclecticism, as in the semi-Assyrian monsters over the windows on the exterior of his library, and the use of eastern lattice work and stained glass, but his eclecticism was not of that undiscerning character, which is so generally prevalent, by which crude and unmeaning features are frequently tacked-on to a spurious Gothic, but everything that he introduced was so assimilated that it might have been the work of an architect of the Middle Ages.

R. REYNOLDS ROWE, F.S.A., *Fellow.*—I ask, Sir, to be permitted to give a brief description of an early work executed at Gayhurst, in Buckinghamshire, formerly the seat of Sir Everard and Sir Kenelm Digby, then of Lord Keeper Wrighte. This was leased to the late Lord Carington with terms for purchase. In 1857 I made a careful set of drawings of the mansion, with details of every part; these were handed to my friend William Burges, under whose direction £20,000 were expended by Lord Carington in alterations, enlargements and decoration. The mansion and grounds are distant about four miles from Newport-Pagnel Station, and are well worth a visit. Much of the Gunpowder Plot was concocted there, and thence Sir Edmund Digby was taken to execution. The main block was built by the Digbys, *circa* A.D. 1560. The south and east fronts have remained in their original state; the north front was raised in the centre, window-sashed and classicalized in the reign of George I. William Burges designed a state staircase of much grandeur, which was not executed; a secondary staircase he built in stone bearing quaint inscriptions. In the dining-room he built two fireplaces reaching to the ceiling, sculptured in *alto* on their faces; on the one, the Temptation and the Loss of Paradise; on the other, an angel delivering to Adam a spade and to Eve a distaff. Hooded fireplaces were put into other rooms, some being like those in his own house, bearing figures in *alto* of monkeys stealing apples. The drawing-room was originally lined with panelling without character, and had become much dilapidated: William Burges cleared it away, and fixed new panelling, every panel being beautifully painted with fruit and flowers by a foreign artist; he placed in this room an ornate chimney-piece of stone, richly decorated with gilding and colour. He built new servants' offices on an extensive scale, a well-ventilated kitchen fit for a College, having an open roof and a well-ventilated lantern for the escape of culinary fragrance at one end. On the first floor are the apartments of the *chef*, approached by a staircase in the dinner-bell turret. The sitting-room of the *chef* has a stone oriel window next the kitchen, so that he can, from that point of vantage, oversee the work going on when not actually on duty himself. The top of the dinner-bell turret is a thorough piece of William Burges's work, quaint and picturesque. Retiring-rooms for the female domestics are ingeniously and unobtrusively arranged in their respective departments; similar provision for the men-servants was made adjacent to the butler's pantry and footmen's rooms, by building a quaint stone circus lighted and ventilated by roof dormers, and surmounted at the apex of the roof by a boldly sculptured Cerberus with red glass eyes in each of his three heads. By his ingenuity, what might have been a difficult problem has been turned into an object of beauty and interest. He adorned the garden by laying-out geometrically rigid flower beds to harmonize with the style of the mansion, and planting yew hedges, having stone

pedestals in them at intervals. Although the new work harmonizes thoroughly with the old, yet there is no slavish copying; some details are a little like those of a French chateau, but the whole bears the special impress of William Burges. Having had the privilege of his friendship for a quarter of a century, it seemed a duty to come up from the country to ask permission to show you a ground plan and some photographs of Gayhurst, and to add this humble testimony to the worth of the earnest worker in the true principles of art, who has been thus early removed.

CHARLES FOWLER, *Fellow.*—I had the pleasure of knowing our late friend for several years, and I valued his friendship very much, although in many respects our tastes were divergent. At a very early time I learned to admire and respect his great knowledge, of which it was only after some years of acquaintance one became thoroughly aware. He did not at all obtrude it; on the contrary, I think, as a rule, he really seemed to a comparative stranger or acquaintance one who affected only to be quaint, and did not at all display the wonderful knowledge which he had acquired by years of patient research. From a very intimate acquaintance with him in early life, I knew that circumstances were by no means encouraging to him in the pursuit of his art. He had a great deal of difficulty to encounter, and, although he might have had his way smoothed for him, it was made rather rough than smooth as far as I know; and it was only when he had forced and conquered success that he was encouraged in those quarters where he might have looked for greater encouragement in earlier times. That, I believe, Sir, is correct, as far as I could gather from his own personal conversation.

EWAN CHRISTIAN, *Vice-President.*—All that I knew of Mr. Burges made me wish to know more. He was one of the most thorough men I have ever come across—a man who never did anything he undertook imperfectly; and certainly some of the drawings I have seen from his hand are most admirable examples both of practical and artistic work—that fine working drawing of the *flèche* at Amiens, for instance, is one of the best of its kind I have ever seen. One thing which Mr. Burges told me of himself interested me very much. Most young men, when they have completed their articles, want to get into practice and be doing something; but he said that he had learned how to wait. He had determined from the very first to take abundant time for study, to labour diligently to make himself a master of his work before he began to practise. He could not have worked on a better principle. Every man has not the same power which Mr. Burges possessed, nor blest with such means as he enjoyed, but still, with a little self-denial, most people could do what he did, even if they had not the means. When his opportunities came he was ready for them. That is the way for a man to make himself master of his profession, whatever it may be, if only he uses ordinary diligence. Mr. Burges's designs were all remarkable; but the only design of his I had an opportunity of thoroughly examining was that of the Cathedral at Edinburgh, and certainly that was a lovely one. Having to report on all the drawings sent-in for that cathedral, I had the best possible opportunity of judging whether he had thoroughly studied his subject, and in that particular I was most completely satisfied. The design was perhaps not quite in accordance with Scotch ideas; but still I should have been very glad if it could have been executed. As to St. Paul's I differed entirely with Mr. Burges. I think the idea of skinning the surface and putting marble where Sir Christopher Wren only intended and had put solid stone, was horrible; but he nevertheless produced a most magnificent design, only I am glad to think it was never

carried-out; for if it had been executed, it would have ruined his fame for ever. One or two of his works I have seen, as, for example, the tower of Cardiff Castle. The drawing exhibited here does not do justice to it. It is a beautiful drawing, no doubt; but the building itself is a far finer thing than is there represented. It is a beautiful object, a sort of thing that you may regard again and again both pleasurably and profitably. I do not think, however, that Mr. Burges could ever have become a popular architect, because people do not choose to live nowadays in thirteenth-century rooms, and, for my own part, I could not sleep in such a bedroom as that he designed for himself. It is not a place for repose. I think there can be no doubt with any of us that in the last year—"that terrible year," as Mr. Beresford Hope very truly called it, of 1881—there were two losses in our profession that are absolutely irreparable in this generation. Street's death everybody acknowledges was an irreparable loss to us, and so also was that of William Burges. It takes a very long time to bring a man to such a state of knowledge and perfection as each of those men had reached during years of laborious study. It is a loss which every one of us must ever lament, as I do myself every time I think of it. However, such was the will of God, and we cannot say a word to the contrary. I must be permitted to add one bit of criticism. Mr. Pullan told us about the enormous time Mr. Burges spent in designing a portcullis. It strikes me that was a pure waste. What do we want with portcullises in these days? It may be a nice and ingenious study, but in a practical sense it is a sheer waste of time. We want to adapt ourselves to the requirements of the day, and not to be studying how to construct things that never can again be serviceable. A portcullis is of no use in these days of scientific artillery.

The CHAIRMAN.—It is impossible to speak in other than friendly terms of our departed colleague, who, with all the knowledge and wisdom of the man, was sometimes fond of appearing to be a child. I had the advantage of knowing Burges for twenty-five years, and he was ever a pleasant and genial friend. People have said that his comic humour was not always in season, but the fault was not that of the heart. Those who knew him could easily recall characteristic anecdotes of him, or some piece of good-natured satire to which he had given utterance.

Professor ROGER SMITH, *Fellow*.—I should not like an evening devoted to the works, and to some extent to the personal character, of so highly-valued and so old a friend as Mr. Burges to close without adding one word of testimony to his admirable personal character and his great talents. Many people were, I think, very much unaware of the high worth of Mr. Burges's character and the large fund of genuine kindliness there was underneath his playful and sometimes rather brusque exterior. I do not think I have ever met with any man from whom I have received so much delicate and kindly courtesy, and whose friendship has been so unobtrusive and yet cordial. I had the good fortune to have some hand in procuring for him the commission for the Bombay School of Art, and he never seemed to forget the circumstance, and never lost an opportunity of reminding me that he did not forget it. One point not much alluded-to was the fact that, in spite of his strong mediæval turn, he was by no means a one-sided architect; and that he not only understood but practised other styles than those of the twelfth and thirteenth centuries ought not to be left unrecorded here. His appreciation of and love for Greek art was very great, and his knowledge of the early Italian art was not only great, but practical. I remember on one occasion telling him that I was in search

of some details of the best Francis the First buildings not published, and he said, "Come round and have some lunch with me, and I will show you my sketch-book"; he then showed me and lent me a large volume of sketches of Renaissance buildings, such as one would not have suspected him to have cared to draw, and to which he must have devoted a very large amount of time. With regard to his designs for the decoration of St. Paul's, the work (it unfortunately has not secured Mr. Christian's approval) showed, as it seems to me at any rate, a thorough appreciation of Italian architecture and decoration. I venture to believe that this design was Mr. Burges's greatest work, and that it was not carried-out is probably the most unfortunate thing in connection with his career. Had it been carried into execution, we should have had a building as beautiful internally as it is grand externally; one which might have approached to the splendour of St. Peter's, and would certainly have been consistent and brilliant in its colouring. What it may be now, under the present divided councils, one almost dreads to anticipate. At any rate, whether we like Burges's design or not (and I think there are many, of whom I am one, who admire exceedingly the whole scheme), we cannot but admit that it was the work of a man who had thoroughly mastered the principles of the Italian decorative art he had adopted, as well as those of the mediæval art of the twelfth and thirteenth centuries.

C. FORSTER HAYWARD, F.S.A., *Fellow.*—I would simply remark, in reference to this subject, that some men are mere accumulators of knowledge, and some only dispensers; but Mr. Burges was both. He was, as we know, one of the most learned men in his own peculiar way, and he was always studying and adding to his accumulation of knowledge; but one of the brightest features of his character was, that he was equally ready to dispense that knowledge to his fellow men. He never kept his information to himself, but was always ready to assist any one with any information on any technical matter which might have taken him years of study to find out. Mr. Pullan has said that it would take a whole evening to describe his designs for the furniture for Cork Cathedral alone, and in the same way most of Mr. Burges's work is worthy of minute description and complete illustration. Why, therefore, I ask should not we have an evening here devoted to the study of this particular work at Cork? There should be an evening especially devoted to some definite work that Burges made his own, such as these Cork Cathedral designs and other furniture work. If anyone would take the trouble to examine all his drawings in one particular line—be it wood-work, metal-work, masonry, &c.—the study would well repay an evening devoted to each; and we should be only doing what Burges himself would have wished—making a minute study of his labours and taking advantage of what he had accumulated and would have been willing to dispense to any of us. With regard to the photographic and other illustrations on the walls, I am a little jealous for this Institute, inasmuch as I am not aware that it possesses any of the series, and I cannot conceive anything that would be a better memorial on our part of our deceased friend than to get, either by means of a special fund or in some other way, a copy of the series of photographs of his drawings and designs for the library of this Institute. I know we have been able to purchase certain volumes of his drawings, but that does not meet my wishes with regard to the Institute, and I think that more should be done to show our appreciation of the genius of our good friend, of whom it may truly be said that, although "dead, he yet speaketh."

OCTAVIUS HANSARD, *Member of Council.*—I cordially echo all that has been said

of the personal character of Mr. Burges. There is one point which ought to be noticed more fully than it has been, namely, the extraordinary talent he displayed as a designer of goldsmith's work. I would ask you to refer to the volumes of designs recently purchased for the Institute, which, although containing but few illustrations, show his extraordinary power, diversity of genius and method of working, proving that he was able to imagine and cause to be executed in the most perfect manner the smallest detail, from the ring on the finger, the gems on the chalice, around the bishop's mitre or his pastoral staff; he knew not only how to design, but how to fix even the smallest portion of his work.

R. P. PULLAN, *Fellow.*—The Chairman and other speakers have accused me of brevity. I have not read half that is in my manuscript, for I feared that technical descriptions of buildings would fatigue you, and again, I knew that there were many friends of Mr. Burges who would naturally wish to say something about him. I quite agree with Mr. Christian as to the magnificence of the design for Edinburgh Cathedral. There is no central tower, as at Cork, but a *flèche* at the intersection of nave and transepts. The sweep of the semicircular apse begins at some distance from the transept; this gives dignity to the choir. Altogether, I think it the best of Mr. Burges's ecclesiastical designs.

*** The Report which accompanied Burges's Competition Design for the Law Courts contained an Appendix headed "Style of Architecture" as follows:—

"It is by no means favourable to the architecture of the 19th century that an architect should have to say anything about the choice of a style. In every other age but our own, but one style was in fashion at one time, and every artist designed in that style. Now, however, it is very different. When we consider the traditions with which our English laws and constitution are surrounded, we naturally seek for some style of architecture which will recall these traditions, and at the same time be the best of its kind. These conditions are fulfilled by the architecture of the 13th century. Now the architecture of the 13th century had distinctive expressions in different countries; thus, that of England was distinguished by great multiplicity of parts, and the buildings were comparatively small, for we were not then a rich nation. That of France was not unlike that of England, but the buildings were much larger, and the mouldings fewer and bolder. That of Italy presents us with enormous edifices, but the ornament and moulding is very subtle and delicate, suited to the marble in which it was executed, and to the amount of light it received from the sun. The last influence had much to do with the smallness of the windows and the breadth of the composition. In selecting the exact variety of the 13th-century architecture to be adopted, we naturally give the preference to that of our own country; the only objection to this course is the small mouldings and ornaments which, in the comparatively soft stone employed for building in this city, are so certain to be clogged and obliterated by the acids and smoke of the London atmosphere. We are, therefore, driven by the exigencies of the case to the broad details of the French work, and I have accordingly used these details, preserving as much as possible of English feeling in the composition, *e.g.*, the multiplication of small windows and niches, &c. As to the Italian phase of 13th-century architecture, I cannot possibly see one single reason, except fashion, why it should be introduced into our country; it grew out of, and is alone suited to, certain exigencies of atmosphere and material which we do not obtain here in England;

and I can hardly conceive anything so utterly inapposite as the great English Palace of Justice executed in Italian Gothic, recalling no one national tradition, and only serving as a wonder to our descendants some fifty years hence. Now, there is comparatively little difference between the English and French phases of 13th-century art, and some of our buildings, such as Westminster Abbey, bear indubitable evidence of the study of French work on the part of our ancestors; and there is very little doubt that had it been their lot to have contended with a smoky atmosphere and destructive gases as it is ours, they would have enlarged their fenestration and their details to meet the circumstances of the case; for after all, logical reasoning and common sense have, and have had, a great deal more to do with the development of the art of architecture than is commonly supposed. The style being thus settled, I would treat it simply as a "point de depart," the latest improvements in materials, construction, and convenience should be applied whenever and wherever they can be proved to really be improvements. Sculpture and painting should take the place of mere ornament wherever possible, and the whole edifice should, in fact, become one of those books in stone telling us, not only of the deeds of our ancestors, but of the wondrous progress of the 19th century in science and literature. As in the arts of literature and music so in the art of architecture, a certain rhythm and repetition are absolutely necessary in all works of any magnitude, and this sometimes in a very marked degree. I have therefore endeavoured to procure breadth and unity by following out this principle in my design."

IX. RECENT PROGRESS IN THE ELECTRIC LIGHTING OF BUILDINGS.

By JOHN SLATER, B.A.(Lond.), *Fellow.*

[Read on Monday, 15th May, 1882, Horace Jones, *President*, in the chair.]

IN the Spring of 1879, that is just three years ago, a Committee of the House of Commons investigated the subject of Electric Lighting and examined a number of witnesses, and it is most interesting to refer to portions of the evidence then given. Mr. Conrad W. Cooke expressed his opinion "that in small and narrow streets and in small shops electric lighting could not be applied at all." The Borough Engineer of Liverpool said: "The Electric Light may be applied as a luxury to private houses but not economically." Professor Tyndall "did not think that a light of 10,000 candles produced by one current, could be divided into 10 lamps of 1000 candles;" while Sir W. Thomson "could scarcely answer the question as to domestic supply, as there was so much to be done before it could really be made practicable." The report of that Committee dated the 13th June 1879, states, that "unquestionably the Electric light has not made that progress which would enable it to enter into general competition with gas, for the ordinary purposes of domestic supply." Thus it is clear that so short a time ago as the date mentioned, the most eminent scientific men of the day were of opinion that the minute sub-division of the electric light was impracticable, and that however widely extended its use might become for illuminating streets or large areas, there was no immediate prospect of its superseding gas for domestic purposes. These opinions must have had very great weight at the time they were expressed, but fortunately for the world inventive genius has never shown itself willing to accept the dicta of scientific men however eminent, when attempting to predict the limits of usefulness of any new discovery, and the Electrical Exhibition in Paris last year, followed by that now being held at the Crystal Palace, has afforded practical evidence of the danger of prophesying "unless you know." At each of these exhibitions several different systems of lighting were shown in active operation, which had completely solved the problem of the indefinite sub-division of the electric light, and which proved to demonstration that there is no greater difficulty in arranging for lighting a house with any number of small lamps by means of electricity, than when gas is the illuminating agent. The probability is that at the present moment there would be an almost unanimous agreement among electricians, that electric lighting cannot possibly have its full scope, and achieve that position as a public boon which its advocates claim for it, until those purely legislative restrictions which now form the chief impediments in the way of its being extensively used for domestic purposes are removed. The cause of this revolution of opinion is to be found in the invention of incandescent lighting which was unknown at the time when the Parliamentary Committee inquired into the subject. It is in the development of incandescent lighting that the most remarkable progress has been made during the past year, and as this form of lighting is undoubtedly the one with which in the future we architects shall be mainly concerned, inasmuch as it is that which will be chiefly employed in the interiors of all buildings, I shall devote a considerable portion of this paper to an examination and description of the

various modes of incandescent lighting now employed, their adaptation to our requirements, and their proper function as a means of decoration. Next, I shall briefly describe the recent improvements in the arc-light systems; and thirdly, I shall examine the social aspects of the question, describing the distribution and measurement of the electric current, and hinting at the lines upon which legislation on the subject should proceed.

This incandescent lighting of which the rush to the front has formed the most marked feature of last year's progress, what is it? It may be defined to be the unlimited power of concentrating into small foci large quantities of heat without the consumption of the heated body. Heat and light are one and the same thing but perceived by us through different channels, and we know that the higher the temperature of any substance is, the greater is the proportion of the heat energy that becomes visible as light, so that the smaller the area upon which we can expend a certain quantity of heat, the more light we get from it. In the arc lamps, which were the first to show the capabilities of electricity as a means of producing light, this concentration of heat into small foci was carried a long way, but in these lamps the carbon points upon which the heat energy was expended, were continually changing and wearing away, so that no steadiness of light could be obtained without elaborate mechanical arrangements for keeping the points close together; but the incandescent systems, which are based upon the fact that, if preserved from combustion, carbon is practically infusible, have given us the power of obtaining as a source of light an unchanging and perfectly stable body, of getting heat energy poured out at any one point where we require it, and in fact of rivalling the fabled carbuncles of Eastern story which of themselves emitted the most brilliant radiance.

When a current of electricity passes along any circuit, heat is generated, and the amount of this heat is proportional to the resistance of the substance forming the circuit. This resistance depends partly upon the nature of the material itself, and partly upon its size. Thus with copper wire which is one of the best conductors that can be obtained, the resistance is very much less than with platinum wire of the same size. If the size be varied the resistance varies inversely as the square of the diameter of the wire, so that a current of a certain strength could be sent through a wire a quarter of an inch in diameter, without perceptibly raising its temperature, while the same current would heat a wire of one-sixteenth of an inch considerably, and might fuse altogether one of half that size. It is a common enough experiment to send an electric current through a piece of platinum wire which speedily begins to glow in consequence of the heat generated by the passage of the current, and if such a wire were raised in this manner to a white heat, it would be the simplest form of an incandescent electric lamp. Carbon, as offering greater resistance to the electric current, would be raised to a higher temperature by the same current and would glow more brightly, but if such an experiment were made in the air, the oxygen of the latter would at once combine with the carbon and cause it speedily to burn away. Hence it soon became evident that if carbon was to be used as a substance through which an electric current should continue to pass for any considerable time, maintaining the substance in a state of incandescence, it must be preserved in a vacuum,—or at any rate in an atmosphere from which oxygen is excluded. Several metals and alloys of metals were experimented-upon, but none were found capable of being raised to a heat sufficient to make them brightly incandescent without speedily being fused, so that inventors

were driven, in spite of the disadvantage to which I have referred, to have recourse to carbon, which is the most refractory substance known; and it follows from what I have just stated, that in order to obtain the maximum resistance the carbon must be of very small size. For lighting purposes the envelope inclosing the carbon must of course be transparent: and thus the problem set before inventors was "how to inclose in an exhausted glass globe a thin filament of carbon connected with wires outside the globe." When we consider that the vacuum in which the filament is confined must be of the most perfect character, that the filament itself must be of the most extreme tenuity, that it has to endure a temperature at which steel would be instantly melted, and that in its ordinary state carbon is much too brittle to be formed into the proper shape, it is evident that the constructive difficulties in the way of making a good incandescent lamp are very great, and I propose briefly to explain the way in which these have been surmounted by the various inventors.

The principal incandescent lamps are the Swan, the Lane-Fox, the Edison, and the Maxim. To Mr. Swan of Newcastle is due the credit of having been the pioneer in this field of invention, and he has been fortunate enough to see the practical fruit of his patient endeavours. The form of the Swan lamp [see Illustration No. 11., fig. 1] must be now tolerably familiar to every one. It consists of a thin filament of carbon formed of cotton thread, which has been "parchmentized," that is treated with sulphuric acid till it is reduced to a pulpy state, and then carbonized in a furnace, after which it becomes hard and elastic. The thread after this process has its ends attached to two thin wires of platinum which are kept apart by having glass fused around and between them, so as to form a solid little column of glass. The whole is then introduced into a small glass globe with a short neck, to the top of which the little glass column is attached by fusing Platinum wire is used because its expansion under heat is almost exactly the same as that of glass. After the thread has been placed in its proper position the globe is attached to the tubes of a Sprengel air pump, and is gradually exhausted down to one millionth of an atmosphere. Then the carbon thread is slowly heated by the electric current, while the air pump is kept at work in order to exhaust whatever oxygen has been occluded in the carbon, and after this process the globe is fused by the blow-pipe at the point of its attachment to the pump and is thereby closed and detached, and the lamp is complete.

The Lane-Fox lamp—which is now supplied by the Brush Company—is ovoid in shape [see Illustration No. 11., fig. 2]; the carbon filament which is circular in cross section is made from the root of an Italian grass used for making brooms, which is cut into the requisite shape. As this is a natural substance it is sufficiently homogeneous to allow of the acid treatment being dispensed with before carbonization, but as it is almost impossible to find two blades of grass precisely alike in thickness or molecular formation, these filaments have to be tested after carbonization and classified according to their resistance. They are then heated by the electric current in an atmosphere of coal gas, the vapour of which is decomposed, and carbon is deposited on the filaments, the inequalities of which are thereby diminished and the resistance equalized. The filament is attached to platinum wires which pass through tubes in the top of the hollow glass stem, and have their ends surrounded by mercury in the tubes.

Mr. Edison, who appears to have ransacked nearly the whole vegetable kingdom in search of a suitable natural material which his experiments led him to believe would be more

uniform than any artificially formed carbon, has finally fixed upon a certain kind of Japanese bamboo as the substance best adapted for carbonization, and it is important that the bamboo should be cut at a certain stage of its growth in order to secure uniformity. I am informed that Mr. Edison employs two practical farmers in Japan for the express purpose of selecting and transmitting this bamboo. Specially prepared machinery cuts up the pieces of bamboo into threads of square section of exactly the thickness required for the lamp, and these threads are bent into the form of a U [see Illustration No. 11., fig. 3], placed in a nickel mould, and set in a furnace, and turned into carbon. By this means all the threads are kept uniformly thick, and equality of resistance is insured. The filaments are connected with the platinum wires by means of copper, which is deposited on them electrolytically.

The Maxim lamp [see Illustration No. 11., fig. 4] is globular in form, and has a short neck within which pass the conducting wires of platinum, which by means of fusing the glass all round them are formed into a solid column, which is attached to the top of the glass neck partly by fusing and partly by a seal of enamel. The filament is made of cardboard, cut into an M shape, and carbonized in a mould, and it will be noticed that this filament is of much larger sectional area than in the other lamps, and it is additionally thickened-out where it joins the platinum wires, to which it is connected by platinum clips. After being placed in position the globe is exhausted, and the filaments are heated by the electric current in an atmosphere of hydrocarbon vapour in much the same way as in the Lane-Fox lamp, and the carbon of this vapour is precipitated on the filament at its hottest and weakest parts, and it is thus rendered almost homogeneous, and able to sustain a much stronger current than would otherwise be the case, and this means that it will glow with a much greater brilliance if required, and will last much longer.

The method by which these lamps are connected with the circuit wires, and fixed on brackets or chandeliers, varies somewhat in the different systems, but in the latest and simplest form of the Swan lamp it is managed in this way. A small cylindrical knob of ebony or ebonized wood (see fig. 1) has two little platinum hooks inserted in one of its faces, and these are connected with two binding screws, to which the circuit wires are attached. The platinum wires in the globe of the lamp terminate outside in two small loops, which are fastened to the little hooks in the ebony knobs, and are kept closely pressed against them by a spiral spring which encircles the prolongation of the globe, and thus good electrical contact is secured. On the face of the knob opposite to that on which the platinum hooks are fixed, is a short screw, by means of which the knob can be fixed to a bracket, or even to an ordinary gas fitting. By simply unhooking the globe (which is never so hot that it cannot be handled), contact is broken, and the filament goes out. This, however, is not the way in which the lamps are ordinarily extinguished, as I shall describe later on. One of the greatest advantages of the incandescent systems of lighting is that they are equally adapted to either continuous or alternating currents, and can thus be used with almost any dynamo machine, but as I described these machines in a former Paper* I shall not further refer to them now.

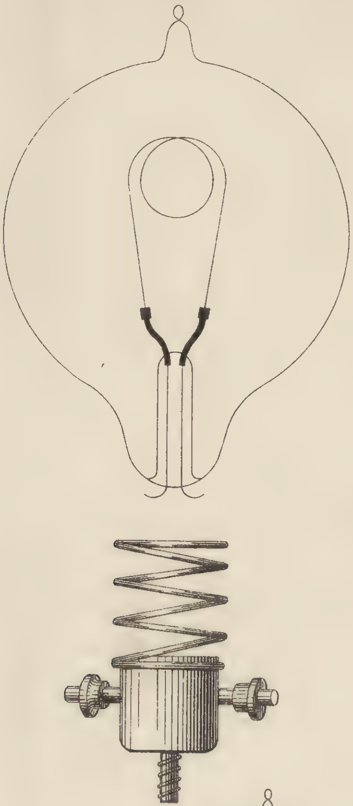
There is, however, one invention of which only faint whisperings had been heard when I last had the honour of addressing you on this subject, which bids fair to be of the very first importance in facilitating the spread of incandescent lighting: I allude

* See the TRANSACTIONS, 1880-81, pp. 195-198.

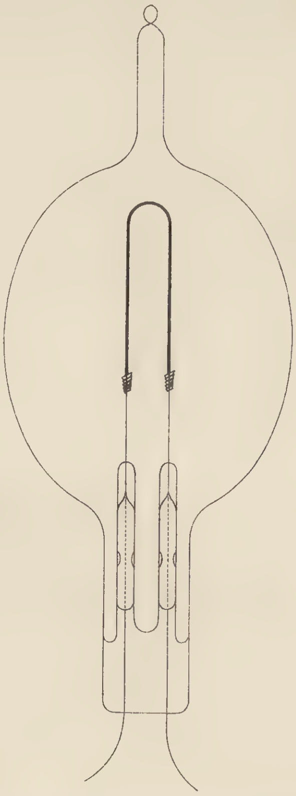
RECENT PROGRESS IN THE ELECTRIC LIGHTING OF BUILDINGS, (No. II)

INCANDESCENT LAMPS.

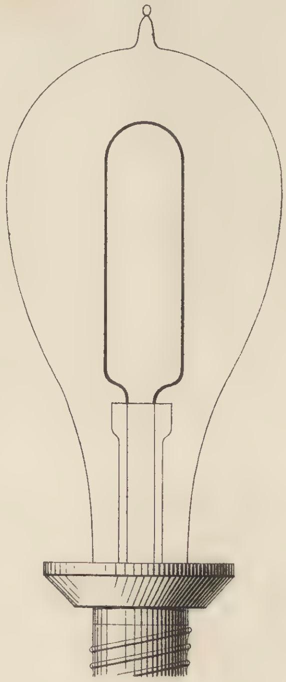
Swan.
Fig. 1.



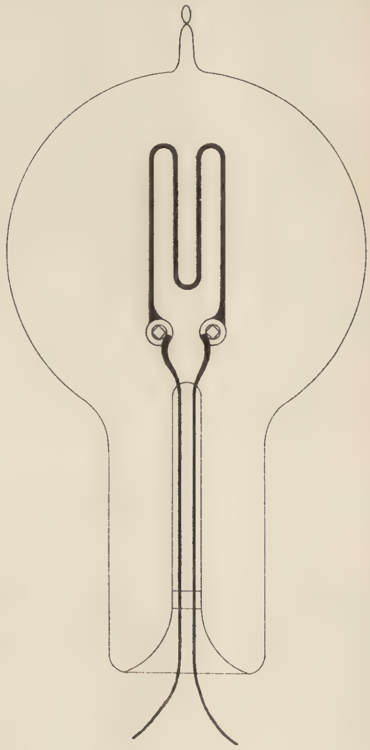
Lane-Fox.
Fig. 2.



Edison.
Fig. 3.



Maxim.
Fig. 4.



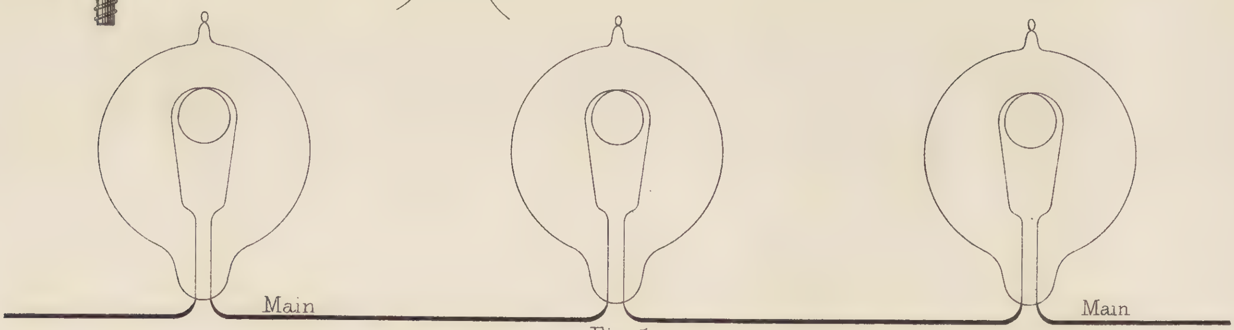


Fig. 5.
Arrangement of Incandescent Lamps in Series.

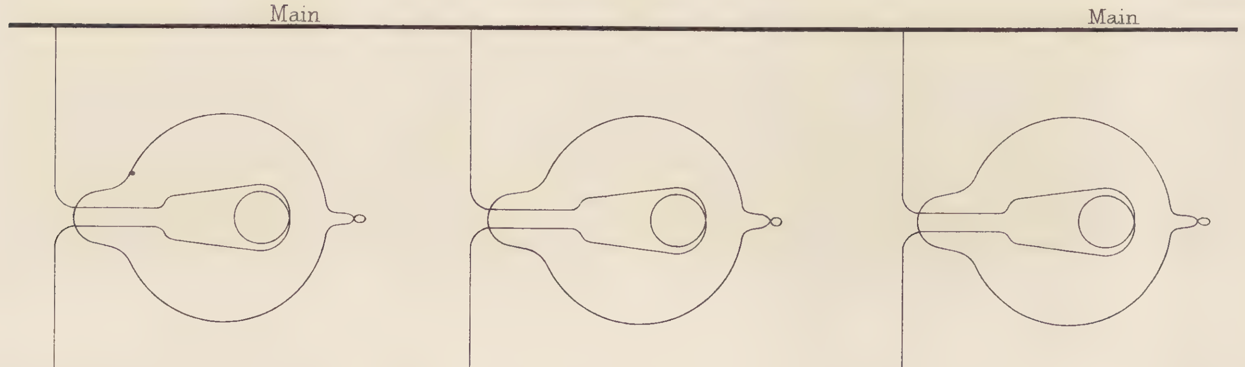


Fig. 6. **In Multiple Arc.**

C.F.Kell, Lith. Castle St. Holborn, London, E.C.

to the storage batteries or accumulators of electrical energy, the invention of which, in a practical working form, marks an epoch in the history of electric lighting. The idea of these secondary or storage batteries is not new. Even before Faraday's time various electrical experimenters had discovered the fact that feeble currents of electricity could be obtained from wires that had been attached to an ordinary battery used for electrolytic purposes, after they were disconnected from that battery. The cause of these phenomena was, however, only vaguely guessed-at, and no practical result came of the investigations which were carried on at that time. Faraday's wonderful genius went far towards a complete elucidation of the question, and he showed clearly that if an electric current of certain strength is able to decompose into its constituent elements a certain quantity of a compound mixture, these same constituents, if they could be made to combine again, would reproduce an electric current of *nearly* the same strength as that which was required to separate them; not quite the same, because a certain amount of waste is unavoidable. The problem then was—to quote Professor Adams's words—" to find some compound substance which can be decomposed into two others which will remain apart, even when joined by a liquid conductor, until a complete electric circuit is made; then these substances should be at considerable difference of potential, so as to give a strong electric current in uniting again to form the substance from which they were decomposed." This phrase, " difference of potential," occurs frequently in electrical parlance, and may be defined to mean electrical pressure; just as there can be no flow of water between two vessels in which the fluid stands at precisely the same level, but the flow commences at once, as soon as the level in the one is higher than that in the other, and increases in force as the difference becomes greater, so there can be no electric current unless electrical pressure exist, or in other words, unless there be difference of potential. I am aware that the ideas connoted by these words are not strictly applicable to electrical phenomena, but so little is really known as yet of the nature of electricity that it is impossible to avoid using inadequate expressions.

The first secondary battery, in a practical shape, was made by M. Planté in 1859, and in its simplest form it consists of a series of pairs of lead plates immersed in acidulated water, and alternately connected together. If such a series of plates be connected with the poles of a battery, the passage of the electric current will decompose the water; the oxygen given off will attack one of the lead plates, the positive pole, and will combine with the lead to form peroxide of lead, while the hydrogen will attach itself to the other plate, the negative pole, and form a sort of film upon it. If now the wires from the battery be disconnected, and another circuit be made by connecting wires from these lead plates through a galvanometer, it will be found that the plates themselves now act as a battery, and a current of electricity will flow for a length of time, which is proportional to the amount of peroxide of lead produced. Here, then, was discovered a method of storing electrical energy, which would not discharge itself all at once like a Leyden jar, but which could be used in doing some kind of continuous work. It was found necessary, for reasons which I need not detail, in order to develop in such a series of plates as I have described their full storage capacity, to charge and discharge them a considerable number of times, whereby the lead plates assumed a spongy condition, and as a large number of pairs of plates are required in order to obtain powerful results, it is evident that the formation of a Planté secondary battery must be a work

of great labour and expense. It is, however, the fate of every scientific discoverer to find hosts of eager brains ready to follow up and improve upon his discovery, and hence, during the last few years, there have been several forms of secondary batteries invented, among others by M. de Meritens, and M. Rousse in France, and by Professors Thomson and Houston in America. But the invention to which public attention has chiefly been attracted in this country is the Faure battery, which was patented last year. Instead of adopting the tedious device of M. Planté of obtaining peroxide of lead on ordinary plates by means of repeated electric currents, M. Faure coats his lead plates at the outset with red lead, and is thus enabled to obtain in a few days that spongy condition which had taken M. Planté months to arrive at.

The following description of the method of constructing a Faure cell I have taken from a Paper read before the Society of Arts by Professor Silvanus Thomson. "Six sheets of lead are taken, five of which are about 24 inches by 10 inches, and folded double, the other plate is 12 inches by 10 inches. These are painted thickly with red lead on both sides, and against each side is pressed a piece of felt in order to retain upon the lead plates the mass of the working substance. These sheets are placed side by side in a water tight case, alternate sheets being connected together by projecting flaps. The cell is filled up with dilute acid, and is then charged by means of a current sent through the plates for six or seven days uninterruptedly. The total weight of such a cell, including the acid, is about 50 lbs." In addition to economy of time in forming the Faure cell, it has the advantage of taking longer to discharge itself than the Planté, or in other words, it does not run down so quickly.

The great practical drawback to a battery, formed of such a series of plates as I have described, lies in the necessity for sheets of felt or asbestos, or some such substance, for retaining the red lead upon the plates; for although, in a laboratory experiment, there might be little difficulty in doing this effectually without resorting to such means, it becomes almost impossible, when constructing large batteries for general practical use, as there is so much greater liability to break down. In addition to this there is the extra weight caused by the use of the separating sheets, and the liability to deterioration, through the red lead coating not being an intrinsic part of the plates themselves. Hence, in the most recent form of secondary battery, which I have the pleasure of showing you here to-night in active operation, through the kindness of the inventors Messrs. Sellon and Volckmar, the separating sheets are altogether dispensed-with, and the battery consists of nothing more than a series of perforated lead plates steeped in acidulated water, as in the other secondary batteries, but the perforations are filled-up with a certain substance that is so intimately connected with the lead as to form an alloy with it. This simplicity of construction seems to presage a great and successful practical future for this form of battery.

The enormous advantage of these storage batteries will be evident to all, although what at first appeared likely to prove their most important quality, viz. portability, may probably not turn out to be that which will render them most practically useful. No doubt this portability is a very valuable characteristic, as a battery can be charged with electrical energy, and then used for driving a tram car, or lighting a railway train; but for domestic lighting purposes it will be most admirably adapted for use as a reservoir or cistern interposed between the main lines along which the electric current is conducted from the central generating station, and the small wires for supplying the current to the various

rooms of a house; by this means certainty of supply and steadiness may be insured. These secondary batteries have been so recently brought into practical use that there has not yet been time to make exhaustive experiments as to their capacity and durability; but Professor Ayrton, in a lecture delivered in March last, at the London Institution, announced, as the result of experiments made by himself, that a Faure cell, weighing eighty-one pounds, after being charged, was found to have stored-up energy exceeding 1,400,000 foot-pounds of work; and it seems probable that the efficiency of such a battery increases with use. At the Paris Exhibition, thirty-four Swan lamps were kept burning by a Faure battery of fifty-six cells.*

The most important point to be considered with reference to incandescent Electric Lighting is its economic value. Everyone admits now, that as compared with gas, it is a much cooler light, and much less vitiating to the atmosphere, but can it be used as cheaply? The answer to this question depends very largely on the method of distribution, to which I shall have to refer later on, but as far as light is concerned there can be no doubt it can be *produced* as cheaply as gas. Careful experiments have shown that with incandescent lamps a light of 150 candles can be obtained for every horse-power employed, and this can be increased if the lamp can be worked-up to greater intensity; and the great improvements that have lately been made in steam-engines allow of one horse-power being obtained for every two pounds of coal used in the furnace. The same amount of coal if turned into gas, after making liberal allowance for the waste products of gas manufacture, would only give a light of fifty-four candles. Of course the question of the first cost, and of the renewal of lamps must be taken into account, and hitherto, the average life of an incandescent lamp has certainly been less than 1000 hours, the cause of break-down being a very gradual transference of carbon from one heel of the horseshoe to the other; but there can be no doubt that improvements in the manufacture of the lamps will lead to an increase in the average period of their duration. As to the cost of wires and connections, Sir W. Thomson has stated that in his own house, which is completely fitted up with incandescent lamps, the internal fittings are not more expensive than those connected with gas, excluding in each case the lamps themselves.

Some very important testimony as to the economy of the incandescent lamps was recently given by Messrs. Furlong and Son, of Cork, who have had Swan lamps burning on an average ninety hours per week, for the last few months, in their flour mills, and they say that most of the lamps have been in operation over 1000 hours, and are as good apparently as when put up, and that, after allowing for interest on capital and depreciation, the saving over the gas which used to be burnt is more than fifty per cent. At present, however, it is almost impossible to make any fair comparison between gas and the electric light, the conditions of supply being so widely different.

At the small town of Godalming, in Surrey, may now be witnessed a very interesting installation of electric lighting, which is being worked by Messrs. Siemens. The public streets are lit by six large arc lamps, with intermediate incandescent lamps; and several of the tradesmen have introduced the small lamps into their shops. All the lights are worked

* During the reading of this Paper, the lecture room and vestibule were lighted by 39 incandescent lamps, which were worked by a Volckmar battery of 33 cells.—J. S.

from one generating station. Although the charge to the private consumer is more than that which used to be made by the Gas Company, I was personally assured that the difference is far more than made up by the prevention of the injury to goods which used to result from the continued use of gas light in the shops.

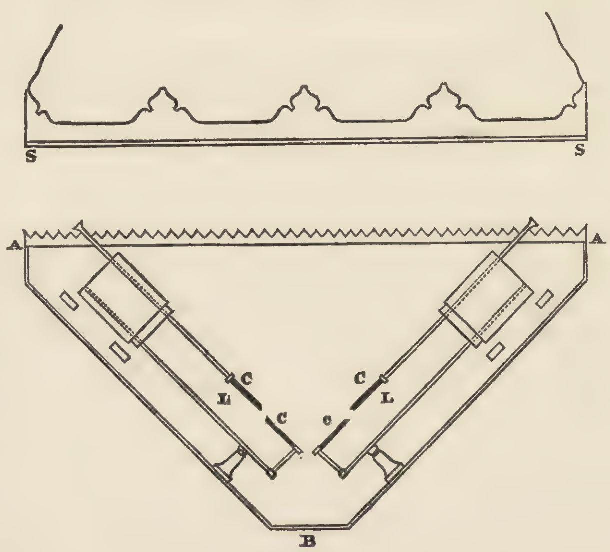
One of the chief advantages of the incandescent systems of electric lighting consists in the readiness and ease with which they lend themselves to any system of decoration, and it is in their artistic arrangement that our ingenuity as architects will have full scope. The Paris and Crystal Palace Exhibitions showed several ways of using the small lights effectively, but, as a rule, I think the fittings were designed too closely upon the lines required for gas. With gas it is impossible to place lamps very near a wall or ceiling, because of the heat and smoke, nor can the number of separate lights be increased largely without considerable trouble and expense. But we should never lose sight of the fact that with electricity we have a means of obtaining points of light wherever we want them, and that we can multiply these points indefinitely. Again, with gas, the hollow tubes must be of sufficient diameter to allow of the passage through them of a certain quantity of gas, but for electrical purposes the various arms of the chandeliers or brackets need only be of thickness enough to admit through them the very fine wires which conduct the current, and therefore much greater lightness can be obtained. The brass electrolier designed by Mr. Faraday for Mr. Swan which was exhibited in Paris in the Refreshment Room, and again at the Crystal Palace, is a very good example of what can be done in this way, and although many have been constructed since of a more ornate character, this will always remain a typical example of artistic simplicity. One of the most elaborate pieces of work exhibited at Sydenham was the electrolier of hammered brass in the Entertainment Court. This was constructed by Messrs. Verity and Sons for Mr. Edison's exhibits, and is in the form of a large basket of various kinds of flowers. The stems are hollow for the electric wires, and the lamps, ninety-nine in number, seem to rest in the calices of the flowers. Another fine specimen of workmanship was the cut glass lustre which formed the support for a number of Maxim lamps in the centre corridor of the Palace. There was also a very good example of a chandelier in one of the Fine Arts Courts, exhibited by the British Electric Light Company, which contained forty-eight lamps, and the same Company's arrangement of their lamps in the Egyptian Court, with Messrs. Elkington's display of Swan lamps close to the High Level Entrance, showed how admirably adapted they are to purposes of table decoration. But in fact there is no limit to the variations in the method of arranging these small lamps. The suite of apartments on the first floor of the Palace, lighted by the Domestic Electric Light Company, showed how the light can be adapted to all kinds of decorative treatment, but the fittings here indicate little novelty of invention. A better plan, which might be adopted in a lofty room, would be to divide the ceiling by plaster enrichments into a series of panels, in the centre of each of which might be placed one incandescent lamp, and the effect of these would be both novel and effective, and there would be not the slightest fear of damaging the ceiling by smoke; and another advantage would be that in such an arrangement there would be nothing incongruous in the appearance of the lamps when unlit during the day-time. For such a room as the Lecture Room of this Institute, a circle of lights round the bottom of the dome, with the leading decorative lines of the

ceiling also picked-out and accentuated by rows of lights, would give a generally subdued and diffused illumination, that, in my opinion, would be most pleasing. Some such system was adopted in the Alhambra Court at the Crystal Palace.

If an electrolier be required, as possibly would be the case in a Dining Room, instead of imitating the thick central trunk of a gaselier, it would be more appropriate to follow the best patterns of hanging oil lamps, and, in fact, the conducting wires themselves might support a ring of lamps. The progress of this system of lighting has been so rapid that, as yet, architects have had no time to turn their attention to its capabilities as a decorative agent, but when they do, it will be found to fulfil every requirement for perfect lighting, in fact, it is doubtful whether imagination itself could picture a more perfect means of illumination.

Having thus attempted to bring before your notice somewhat in detail the great advance made during the past year in incandescent lighting, I must refer much more briefly to the progress of the arc light systems. Whereas the former may be likened to a baby that has shot-up in the intervening time to the full stature of a man, the arc light systems resemble a boy who, having attained his full height, has employed the time in filling-out, and generally developing his strength. The sphere of usefulness and the limits of usefulness of the arc lights have been more clearly defined, and their position in the new field of illumination can now be fairly estimated. That this position is a high one will be admitted by all. For street lighting purposes, for railway stations, for manufactories, and for a large hall or covered area of any kind, no better form of illumination can be found, and the magnificent electrolier for large arc lamps, shown by Messrs. Siemens Brothers both in Paris and at the Crystal Palace, proved incontestably that in the arrangement of these lights decorative purposes need not be ignored. The principal arc light systems which I described a year ago, viz. the Brush, the Siemens and the Crompton, have fully held their own. The Brush Company have supplemented their already numerous installations by many others, of which not the least successful is the lighting of that portion of the streets of the metropolis allotted to them. Messrs. Siemens have greatly improved their lamps in the British Museum Reading Room, which is now most admirably lighted, and Mr. Crompton has not only shown what a few lamps of high power at a considerable elevation can do in lighting a large station like the Great Northern, but has also earned and received the thanks of the employés of that Company, by placing two of his large lights outside the station near York Road, over the net-work of crossing lines where shunting is continually going on, and where accidents, more or less serious, could scarcely, by any possibility, be prevented from occasionally occurring. Mr. Crompton has also obtained at Norwich a renewal of his contract for street lighting in that city. Arc lights have also been used in conjunction with incandescent lamps for the interior of the Mansion House, and a few details of this installation may be interesting. The Egyptian Hall and the Saloon are lighted,—the former by six Crompton arc lamps, and the latter by forty-four Swan lamps. Two dynamo-machines are used for the arc lights, there being three in each circuit, while one machine supplies the current for the forty-four Swans; these are arranged in two branch circuits with three chandeliers in each, two of which contain eight lamps each and the other six. The whole of the dynamo machines are driven by an Otto gas engine of 16-horse power, by Crossley Brothers. It is admitted on all hands that a much larger amount of light is obtained for the horse power expended in the

arc lights than in the incandescent lamps, probably in the proportion of eight or nine to one, so that if they could be worked satisfactorily, there is no doubt they would be more useful in the case of an isolated mansion or public institution, where plant had to be erected for generating the electricity. It appears to me there is only one method of doing this, and that is, as I have before suggested, by concealing the lamp itself and allowing the rays to fall upon a white screen, and thence be reflected into the apartment. This method was adopted in one of the saloons of the Paris Exhibition with the Jaspar lamp, and the result was very pleasing, but the form of the shade for the lamp was not the best that could be adopted. Mr. Crompton also tried the plan at the Smoke Abatement Exhibition, but very roughly. A method of doing this, which I believe if carefully carried out would give very good results, is shown in the woodcut. A B C is a hollow inverted cone either depending from the ceiling or supported by a pedestal on the floor some distance away from the ceiling. L and L′ are two arc lamps placed inside the cone at opposite sides of it, and arranged so that the upper carbon is not exactly in a line with the lower, which must be the positive one. S is a screen fixed close to the ceiling, having its under surface covered with white paper or some other good reflector. When the carbons are ignited they would shed their light full on the screen, from which it would be reflected over the room, and would be very agreeably diffused. The great advantage of having two lamps is that the feeds hardly ever take place at the same instant, and that the slight irregularities of burning caused by the feeds or by inequalities in the carbons, are neutralized, and the rays falling from the screen are almost perfectly steady. In addition to this the ultra blue or violet rays which are among the most unpleasant concomitants of the arc light, are much less perceptible when reflected from a white surface, than when they fall upon the retina directly. If the ceiling were perfectly flat and white, the screen could be dispensed-with. A really carefully arranged experiment of the sort would be most interesting.



The chief characteristics of the progress recently made in arc lamps are: diminished intensity of light, the ability to burn several lights on one circuit, and increased simplicity. Of such lamps perhaps the Weston and the Pilsen promise to be the most effective. In my previous Paper on this subject, I described somewhat fully one of the best of the arc lamps; but the aim of arc lamp manufacturers now is to do away as far as possible with complicated machinery, and to make the electric current itself the only power that accelerates or retards the approach of the carbons to each other. Illustration No. 12, figs. 1 and 2, give a view and section of a Weston lamp. C is the upper carbon holder, the descent of which is controlled by a clutch L, and this, when the lamp is not working, is arranged so as

RECENT PROGRESS IN THE ELECTRIC LIGHTING OF BUILDINGS, (No 12)

Weston Arc Lamp.

Fig 1

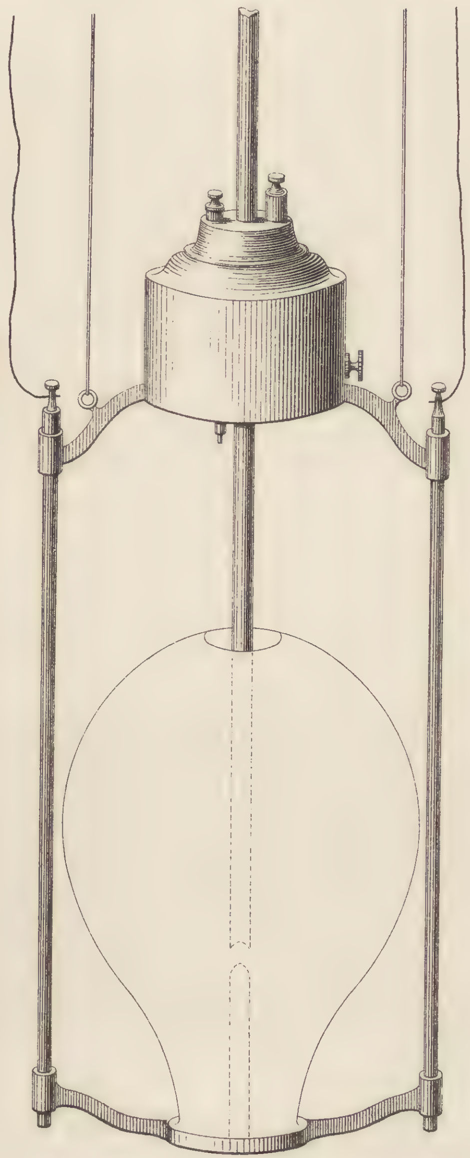
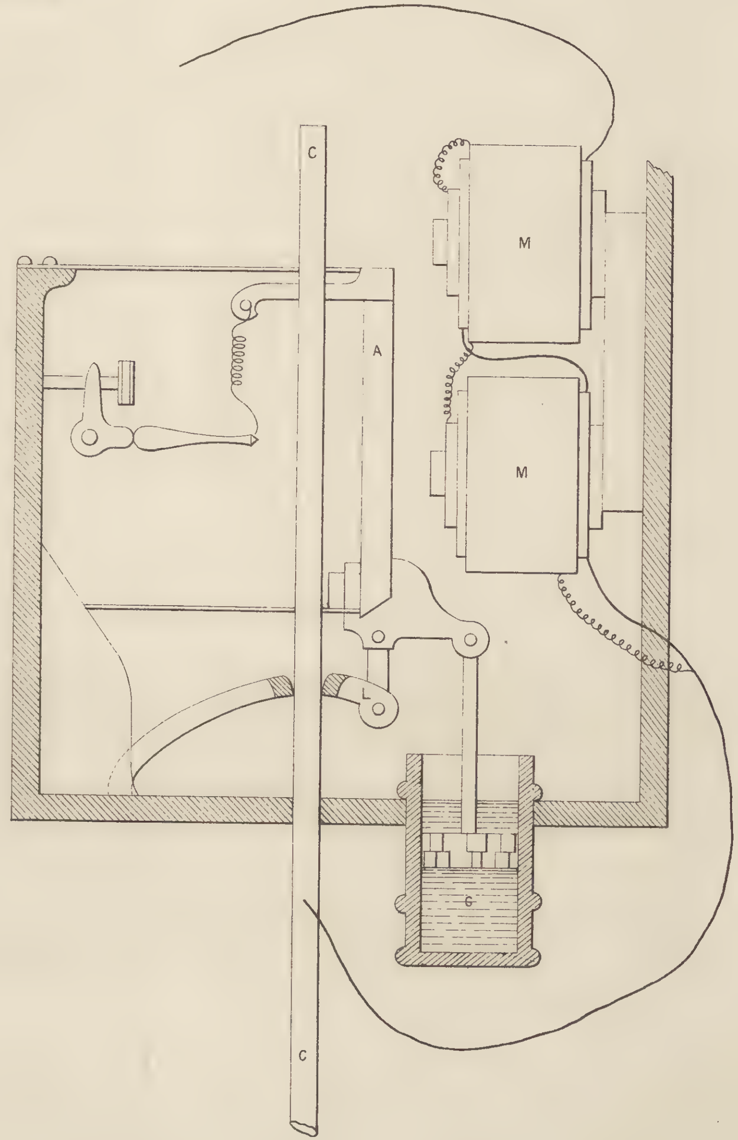


Fig 2



C.F. Kell, Lith. Castle St. Holborn, London, E.C.

to allow the holder to descend freely, and under these circumstances the upper carbon rests upon the lower. MM is an electro magnet which is excited by the same current which goes to the carbons. The magnet consists of a soft iron core wound round with three coils, one of thick wire which is in the main lamp circuit, and the other two of thin wire in a subsidiary or shunt circuit. The two kinds of wire are wound in opposite directions thus giving contrary currents, and if these are equal there is no inductive action and the magnet is inert, but if one be greater than the other the magnet becomes active. The armature upon which the magnet acts is an upright bar B, kept in position by two fixed springs SS, and capable of motion in a vertical direction only, and when at rest the upper edge of this armature is just below the upper pole of the magnet, while at the bottom it is attached to the clutch L in such a way that, when it is drawn upwards by the action of the magnet, the clutch is pressed against the centre holder and lifts it slightly, thus forming the arc between the two carbons. As the resistance of the thin wire of the shunt circuit is many times greater than that of the main circuit, a much larger proportion of the total current passes through the latter, and the magnet continues to attract the armature, while the arc remains the proper length, but as the carbons burn away the arc lengthens, and the resistance of the main circuit increases, and the current passing through it becomes more nearly equal to that passing through the shunt; the strength of the magnet is thus weakened, its influence upon the armature is less, and the latter descends slightly, thus causing the clutch to let down the upper carbon, and thereby to restore the arc to its proper length. The descent of the armature is prevented from being sudden and jerky, by an ingenious method of attaching it to a small piston working in a cylinder containing glycerine. It will thus be seen that this lamp is very simple in construction; it is extremely brilliant, and fairly steady for an arc lamp, and from some tests which were made by Professor Morton in America, it shows a very good result in candle power per horse-power expended. It is this form of lamp that is now being used in Queen Victoria Street, and at the Aldersgate and Farringdon Stations of the Metropolitan Railway.

I have described this lamp somewhat in detail, because it is a simple specimen of what may be called a strictly electrical lamp, as contrasted with a mechanical one. The Pilsen lamp recently invented by Messrs. Pietto and Krizik, is somewhat similar in construction and gained a high reputation at the Paris Exhibition, where it was awarded a gold medal. This lamp like the Weston is very simple in construction, and there are few parts that can get out of order. This is one of the greatest excellencies in arc lamps,—the employment of which will probably be most extensive in large factories, where a certain amount of rough usage will be almost unavoidable. A lamp that attracted a large amount of attention in Paris, on account of its steadiness and the colour of its light, was the Lampe-Soleil, in which a block of marble is introduced between the two ends of the carbon, and is ignited by the electric current and burns away with the carbons. This may be taken as a specimen of a semi-incandescent lamp. No mechanism at all is necessary for this lamp, but as alternating currents are required for it, it is not likely that it will have a very extended sphere of operations. Among other excellent lamps which were shown at the Paris Exhibition I may mention the Jasper, the Gramme, and the Gülcher, but none of these seem likely to prove formidable competitors—at least in this country—to the arc light systems chiefly in use here.

The fact is that the best of these arc lamps are as near perfection—so far as the machinery for regulating the distance between the carbons is concerned—as they probably ever will be, but the great difficulty they have to contend-with is in the nature of the carbons themselves. I alluded to this point last year, and it seems as if very little advance had been made in this branch of electric lighting. Possibly all the manufacturers of carbons have had their hands so full, in consequence of the enormous demand that has so rapidly sprung-up, as to leave them very little time for making the necessary experiments for improving the quality of the manufactured article. But here, as in all branches of commercial enterprise, competition is coming largely into play, and probably another year may witness as much improvement in the carbons for arc lamps, as previous years have seen in the lamps themselves.

I have now to ask your attention to the third division of this subject, *i.e.* the social aspects of the question, for that electric lighting has become a social factor of the highest importance is now beyond question. These social aspects concern the distribution and measurement of the electricity, the conditions that will have to be complied-with in order to secure the rights of the consumers on the one hand, and of the companies supplying the light on the other, and the risks and dangers that have to be guarded against. This is probably the most important practical branch of the whole subject, for, however brilliant may be the means of illumination devized, this will be practically useless unless we can obtain it in our houses easily, safely and economically. Large manufactories, theatres and other public buildings can arrange easily enough for motive power to supply electricity for their own use, either by means of the arc light or the incandescent systems; but just as there would be little consumption of gas if every householder had to erect a small gasworks for his own individual requirements, so it would be both extravagant and impracticable if every one who might wish to use the electric light were obliged to set up for himself a dynamo machine, with gas or steam motor and all the essentials of an electric light installation. For electricity to compete with gas as a general means of illumination, it is essential that it should offer as many facilities as its rival. The following conditions must be complied with in any scheme of general distribution of the electric light: 1st. That any one house shall be in no wise dependent upon any other house for its supply of light; 2nd. That all lights in the house shall be perfectly independent of one another, so that the extinction of one light may not affect the rest; 3rd. That the lights shall be absolutely safe; 4th. That there shall be a simple method of measuring the amount of electrical energy consumed. A year ago it could not be said that any scheme of general distribution of electricity for lighting purposes had been elaborated and proved to be practicable, but there are now two fairly extensive installations of incandescent lighting practically working in London, a few details of which may be found interesting. I allude to that of the Edison system at the Holborn Viaduct and to that carried out by Messrs. Siemens at the Savoy Theatre. Mr. Edison was the first to appreciate clearly the conditions of electric lighting and to see that it would be useless to attempt such lighting on a large scale unless the electric current, in addition to supplying large lights in the streets at considerable intervals, could be utilized *en route* for domestic purposes. In the Holborn installation both street lamps and private houses are supplied, 938 lamps in all being worked from one huge generating machine in the offices of the company on the Viaduct. These lamps are distributed thus: in the company's own offices, 232; in the City Temple, 161; in street lamps between the Old Bailey and Hatton Garden,

164; at the Holborn Viaduct Station Hotel Restaurant, 77; in part of the General Post Office, 50; and in various houses and shops on the Viaduct, 254. All these lamps are arranged so that each separate consumer will have perfect control over the lights in his own building, and over no others, and the amount of electrical energy used by each consumer will be accurately recorded on a metre, as I shall explain shortly.

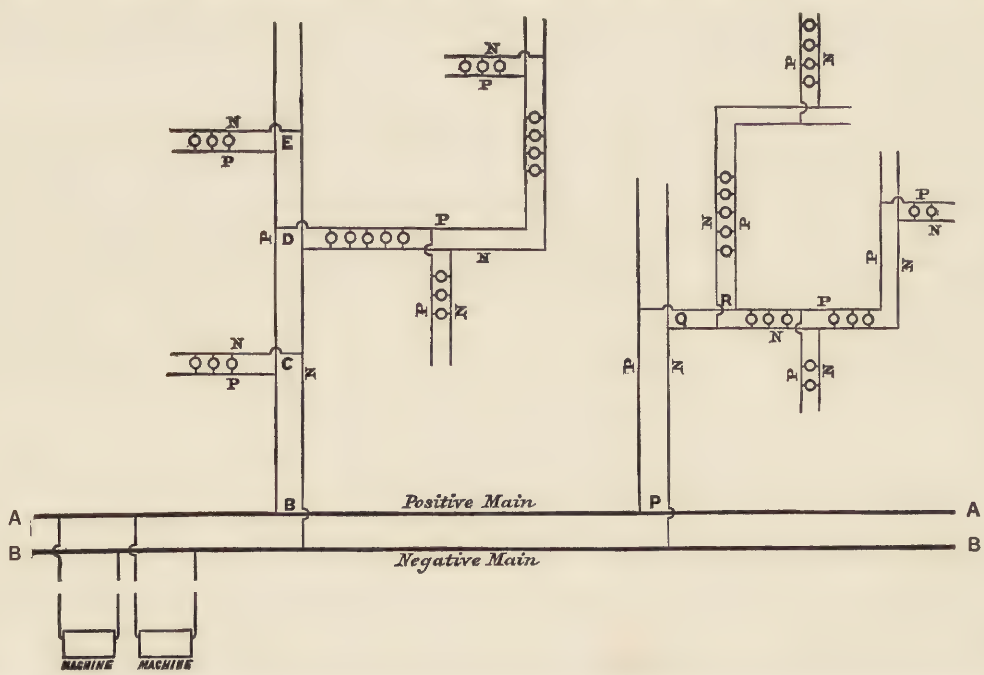
The economic results of this installation of incandescent lighting will be looked forward to with the greatest possible interest, but it is too early to attempt to estimate them yet. One feature of this installation deserves notice, and that is that the steam engine driving the dynamo machine is close to it, and bolted down to the same bed-plate—in fact, it may be said that the steam engine and the dynamo are in one. By this arrangement leather straps from the fly-wheel of the engine to the machine are dispensed with, to the great advantage of the steady working of the latter.

It is not surprising that this installation at Holborn has attracted a large amount of attention. Mr. Edison is fortunate in the *locale* of his first matured experiment, and he is also fortunate in having so able an exponent of his system as the gentleman who manages his London work, Mr. E. H. Johnson. But, without disparaging in the slightest degree Mr. Edison's skill and patience in overcoming the difficulties of distribution, I think it only fair to point out—and this fact seems to have been overlooked in the accounts that have appeared in the daily papers—that the installation at the Savoy Theatre is in every respect as complete an example of general distribution of the electric light as the Edison installation. It would be difficult to find anywhere more onerous conditions than those which have to be complied with in the illumination of a theatre. A supply of light that is adequate, generally diffused, safe and well under control, is absolutely essential, and these conditions are thoroughly fulfilled. As the small lamps burning *in vacuo* do not abstract any oxygen from the atmosphere, their number can be increased *ad libitum* without prejudicially affecting the comfort of the audience, they can be placed in any nook or corner where light is wanted, they may be situated close to the most inflammable portions of the scenery without risk, they can be wholly or in part turned down from one spot near the stage, and they are arranged in different circuits, which are as perfectly independent of each other as if they were comprized in so many different houses. In the Savoy Theatre there are in all about 1,200 Swan lamps of the pattern which I have already described. One hundred and fourteen light the auditorium, 824 are appropriated to the stage, and 220 to the various corridors and dressing-rooms. The lamps in the auditorium are arranged in groups of three, each of which is inclosed in a ground-glass globe, thus insuring great softness of light. The whole number of lamps are worked in six circuits, and, by an extremely ingenious arrangement, each of the circuits can be so nicely adjusted as to enable the light to be varied from a dull red to an intensely white brilliance simply by turning a handle. Thus while the performance is going on the lights in the auditorium are lowered, and during the interval between the acts they are raised to their full power. For supplying the electric current to these lamps six dynamo machines are used, which are driven by three steam engines, and there is expended, on an average, 125 horse-power.

Before long a more extensive installation will be at work, as the arrangements are being rapidly pushed forward for the lighting of the Law Courts and corridors of the new Palace of Justice, but these arrangements are not yet sufficiently matured to enable me to describe them,

though I am betraying no secret when I state that Swan lamps are to be used, and that the electrical arrangements are in the hands of Mr. Crompton.

In order clearly to explain any system of distribution, I must briefly describe the methods of arranging incandescent lamps in a circuit. Suppose A B (see Illustration No. 11, fig. 5) to be an electrical main: we can then attach lamps to this main in the manner shown in the figure, and the current will pass through them all in succession. This is called arranging the lamps in series. But if in this arrangement one of the lamps were to break down, every one would go out, because the circuit would be broken and electricity would not flow. In such an arrangement of lamps as this the resistance to the current is the sum of the resistances of the lamp, plus of course the resistance of the wires, so that with a number of lamps in series a very high electro-motive force would be required to produce sufficient current to render the lamps incandescent. [The current is equal to the electro motive force divided by the resistance, or $C = \frac{E}{R.}$] But there is another way of arranging the lamps, viz. in what is called parallel circuit or multiple arc. Illustration No. 11, fig. 6, shows such an arrangement, when each lamp is connected with both the positive and the negative wires, and it will be at once evident that the breaking down of one lamp will not affect the others. Moreover, in this case the total resistance of the circuit will be the resistance of one lamp *divided by* the number of lamps forming branches, and thus a great deal more light can be obtained with the same electro-motive force in this way than in the previous one. Of course the two methods may be combined, but in this case, if one of the lamps in any one branch fails, the other or others in the same branch will break down also; but the separate branches will be quite independent of each other. Now, Mr. Edison, I believe, invariably arranges all his lamps in parallel circuit, so that each is entirely independent of all the others, and the woodcut will show how this is



done. A A and B B are the main wires, the one connected with the positive terminal of one or more dynamo machines and the other with the negative. These wires may be supposed to represent the electric mains in a street. If at the point C a branch has to be taken off into a house, two wires are attached, the one to the positive, and the other to the negative main, and led in any direction: these may be again subdivided at any point, D, E, F, &c., and wires taken to different rooms or to any number of brackets in one room, and thus each lamp, however far away from the main circuit, will have its terminal wires connected both with the positive and the negative mains. One very great advantage of this method of arrangement is that the electro motive force being small, the currents circulating in the wires are all of low tension, and therefore not dangerous.

In any scheme for the general distribution of electric lighting it is obviously important to be able to regulate the strength of the current in the mains proportionally to the amount of work which it has to do; in other words, supposing the lights in half the houses supplied from one central station were not in use, it would be extremely wasteful to allow the remaining lamps to be raised to a higher and possibly dangerous degree of brilliancy than would be required. This same drawback exists in the case of gas, as we frequently experience in our own houses when the gas begins to roar after the lights in the various shops in the neighbourhood have been turned out, but it would be open to greater objections with the electric light, as the latter is much more sensitive than the former, and moreover an electric lamp, with an ordinary contact tap, cannot be turned *down;* either it burns with its full brilliancy, or it is turned out if contact is broken, there is no intermediate state. It would be simple enough to arrange that the turning-out of any number of lamps should bring into play a coil of wire, the resistance of which to the current would equal that of the lamps turned out; but if this coil were in the lamp circuit only, the generating machine would be doing just as much work as if the lamps were burning; and the electrical energy would simply be employed in heating the resistance coils, and this would be useless expenditure of labour. Hence Messrs. Siemens Brothers at the Savoy Theatre, and Mr. Edison at Holborn and at the Crystal Palace, have arranged resistance boxes in such a way that this varying resistance is thrown into the exciting circuit of the machine; by this means the intensity of the magnetic field of the generating machine is diminished, and feebler currents are transmitted to the lamp circuit, and as a consequence of the lessened intensity of the magnetic field, the driving engine is able to produce the necessary rotation of the generating machine with less expenditure of power. By means of a current indicator and an electro-motive force indicator at the central station, the attendant there is able to tell at once the amount of variable resistance which is required for any circuit. There would be no difficulty in arranging a regulator of this kind in every house, and Mr. Edison has invented a lamp which contains in itself a varying amount of resistance, and which can be turned down at will, but practically this would not be required. With gas it is frequently very convenient to leave one burner just alight, in order to prevent the necessity of relighting it, but with the electric light, as the mere turning a tap lights the lamp, nothing is gained by leaving the lamp alight when it is not wanted. In a theatre, however, it would frequently be very desirable to be able to lower the lights at will, and this is done at the Savoy. The chief difficulty that was experienced at first with these resistance coils for regulating the current to the lamps was the inevitable tendency to heating which they exhibited, and several small fires

occurred at the Paris Exhibition in consequence of the heating of these coils; but both at the Savoy Theatre and at the Crystal Palace spirals of iron wire on skeleton bobbins are used, and as these have a free current of air constantly circulating around and between them, all danger from heating is removed, and it very rarely happens that these coils are too hot to be touched, the heat being rapidly dissipated in consequence of the large amount of radiating surface. This correlation between the light produced at the lamps, and the energy expended at the machine, is one of the most recent and striking improvements connected with electric lighting. The mere fact, however, of these coils heating at all shows that there is a certain amount of wasted expenditure of energy, but with the secondary batteries lights can be lowered or raised without any waste, simply by cutting-out or bringing into play one or more cells of the battery.*

One of the points of the greatest possible importance in connection with electric light distribution is the method of laying the mains, and connecting the various branches. The mains themselves are invariably of copper, but the forms adopted vary considerably. Much difference of opinion existed for some time as to whether the conducting power of copper depended upon mass or upon surface, but the recent experiments made by Mr. Preece, and described in the report of the Lightning Rod Conference, have proved conclusively that it depends upon mass alone. Hence the precise form of the main wires is not a matter of great importance. Mr. Edison uses for his main trunks copper bars, segmental in section, and most of the other electricians use circular wire. The size of the mains must be regulated partly by the maximum length to which they extend from the generating station, and partly by the number of lamps which have to be supplied, these two elements determining the strength of the normal current which will have to be sent through the mains, and the stronger the current the thicker must be the main, in order to avoid undue heating. The various branches led off from the mains gradually diminish in sectional area, until in the rooms of any building the wires become very thin indeed. There is one condition of the very utmost importance in laying wires for general domestic lighting purposes, and that is that from the generating station to the farthest lamp all the wires should be perfectly insulated from each other, and from all surrounding substances. For this purpose the mains should be inclosed in iron tubes, and closely packed round with slag from iron foundries, or some other equally good non-conducting material, such as asbestos, which material probably has a great future before it in connection with electric lighting work. The Brush Company have occasionally laid their wires in a concrete mould cast for the purpose, and this arrangement appears to work very well. It is particularly important that the insulation should be maintained perfect at the points where any branch circuit is led off from the main, and for the purpose of insuring this Mr. Edison incloses the mains in a box wherever a junction is to be made, in which box the wires are soldered to a clamp, so that perfect connection is made; and the whole box is then filled-up with some insulating material. In order to guard against the accidental transmission through the smaller wires of any branch circuit of a stronger current than the wires ought to have to bear, which might lead to heating, it is very desirable to introduce a short length of a fusible conductor into the contact box; this conductor does not come into play at all under normal conditions, as it transmits an ordinary current without becoming unduly heated, but if an excessive current is sent along

* This experiment was shown.

this wire it is at once fused, and thus all connection between the house and the main is cut off. These fusible conductors can be introduced at any point where possible danger might be apprehended.

The method by which the conducting wires are connected with the lamps through brackets, with one or more swing arms, is very simple and ingenious, the two wires from the main circuit being connected to two metallic springs which press upon brass collars connected with the wires which lead to the lamp. All the wires and connections must be kept perfectly insulated from each other, or there would be a tendency in the current to jump across from one to the other, and not to follow the proper course and pass through the lamp. One of the wires on its way to the brass collar is connected with a metallic plate, close to which, but insulated from it, is another similar plate, and the only connection between these two plates is by means of a moveable cone, which can be raised or lowered, and thus separated from or brought into contact with the plates by means of a screw, which is worked by an ordinary tap outside the bracket. While the cone is not touching the two plates, the electric circuit is not complete, and the lamp will not burn, but as soon as contact is made the current passes. It must be borne in mind that this contact breaker is only required for one wire of the circuit.

The points to which I have referred concern the consumer mainly; the measurement of the quantity of electric energy consumed concerns both the consumer and the supplying parties. Various methods of obtaining this measurement have been suggested, but perhaps the simplest is based upon the fact that a certain quantity of current will do a certain amount of work in decomposing some compound mixture. If in a vessel containing a solution of sulphate of copper two copper plates be immersed, one of which is connected with the positive, and the other with the negative, wire of a small shunt circuit through which a definite proportion of the total current supplied to any house passes, a certain quantity of copper will be removed from one plate and deposited on the other, and this quantity will be exactly proportional to the total amount of current. Two such meters could be easily arranged, the one under the sole control of the consumer, the other under that of the Company, and they would act as a check one upon the other. It has, however, occurred to me whether it may not become possible, after a little experience, to do away with the necessity of measuring the electrical energy supplied to each house altogether. After the mains are laid, and the connections made, the cost of generating and supplying the electricity from one station to the houses within a radius of, say half a mile from that station, will be very slight indeed, and it may turn out to be simpler and more satisfactory for all parties to supply the current at a fixed rate per annum, either in accordance with the rateable value of the house, or with the number of lamps fixed, much on the same plan as that adopted by the London Water Companies. This, however, is a question which must be left to time to settle.

It is a point of some importance to decide whether the mains in streets shall be carried overhead or underground. My own opinion is that overhead wires should never, or in the rarest possible cases, be allowed. Wires for electric light purposes are very different from those used for the telegraphs, as in the former case the currents are almost infinitely stronger. With underground wires all needful precautions to insure permanent insulation can be taken by inclosing the insulated wires in iron tubes, but if the wires were carried overhead, and were of sufficient section to be rigid, it would be very difficult to arrange them, or to make

the house connections. If non-rigid wires were used, they would have to be covered with some such substance as gutta percha, and exposure for some time would almost certainly lead to weathering, and this would destroy the insulation; in addition, overhead wires cannot be prevented from being very unsightly. Overhead wires have been largely used in America, and in one or two cases they led to disastrous fires, so that the opinion is generally gaining ground that they should be no longer allowed. Such questions as these, however, and many others connected with the distribution of the light, ought not to be settled privately. The subject is so vast and so important that it has not only made good its claim to legislative sanction, but the interests of the public largely demand it, and the Bill brought forward by the President of the Board of Trade seems likely to treat the matter very fairly from all points of view.*

A question of great social interest suggested by the rapid spread of electric lighting, but one that I have not time to treat fully here, is the possibility of the Electric Light Companies developing into large monopolies, such as the Water and Gas Companies have become. There is, however, in my opinion, but little fear of this, the conditions of supply being so widely different in the two cases. It turns out that it is not practically economical to extend the conducting wires for long distances from the generating stations, inasmuch as the mains must then be very heavy, and copper is an expensive metal. One square mile will probably be the most profitable area to work from one station, and this being the case there will be every inducement for competition between the rival Companies which are now being formed in such rapidly increasing numbers.

It would be idle to deny that electric lighting has its own special risks incident to it, but it may safely be asserted that with ordinary care in laying the wires and making the connections, the danger will be reduced to a minimum. Insulate, insulate, insulate, is the motto that should be always before the mind of everyone who has to do with an electric light installation, and if the insulation of all wires from start to finish be properly looked after, the dangers of electricity will certainly be less than those incident to gas-lighting. One is sometimes amused at the stress laid upon the possible dangers of the new agent by those who are interested in gas, and one feels inclined to suggest that the plaintiff gas should come into court with cleaner hands, for if all the accidents, small and great, for which gas is responsible, from the blowing-out of a window-frame to the terrible catastrophe of a year or so ago in the Tottenham Court Road, were enumerated, the indictment to be framed against it would be formidable indeed. In America much attention has been paid to this part of the subject and the Board of Fire Underwriters of New York have issued the following regulations:—

1. Wires to have fifty per cent. excess of conductivity above the amount calculated as necessary for the number of lights to be supplied by the wire.
2. Wires to be thoroughly insulated and doubly coated with some approved material.
3. All wires to be securely fastened by some approved non-conducting fastening, and to be placed at least 2½ inches for incandescent lights, and 8 inches for arc lights from each other, and 8 inches from all other wires, and from all metal or other conducting substance, and to be placed in a manner to be thoroughly and easily inspected by surveyors. When it becomes necessary to carry wires through

* See Appendix E. for the Electric Lighting Act recently passed.

partitions and floors, they must be secured against contact with metal or other conducting substance in a manner approved by the Inspector of the Board.

4. All arc lights must be protected by glass globes inclosed at the bottom, to effectually prevent sparks or particles of the carbons from falling off the lamps; and in show-windows, mills, and other places where there are materials of an inflammable nature, chimneys with spark arrestors should be placed at the top of the globe. Open lights positively prohibited. The conducting framework of chandeliers must be insulated and covered the same as the wires.

5. When electricity is conducted into a building (from sources other than the building in which it is used) a shut-off must be placed at the point of entrance to each building, and the supply turned-off when the lights are not in use. Applications for permission to use electric lights must be accompanied by a statement of the number and kind of lamps to be used, the estimate of some known electrician of the quantity of electricity required, and a sample of the wire (at least 3 feet in length) to be used, with a certificate of the electrician of the carrying capacity of said wire. The applications should also state where the electricity is to be generated, whether the connection will have metallic or ground circuit, and as far as possible give full details of the manner in which it is proposed to equip the building.

The action of the Insurance Companies in raising the rates of insurance of the Crystal Palace and its contents during the present exhibition undoubtedly caused some anxiety in the public mind, but it must be remembered that the whole of the installations in that building were of a temporary character, many of the leading wires were hastily put up, gas and steam engines of all kinds were busily working, and in fact, the risks were of a totally exceptional kind, and such as could not possibly occur in any well devized permanent arrangement.

I have thus endeavoured briefly to sketch the recent progress of this great invention, and I can imagine some one saying: Yes, this is all very interesting, but how does it affect us architects? It appears to me to affect us most materially. The progress of electrical science is the most striking feature of the latter part of this nineteenth century, and if we are to hold our own we must keep *au courant* with the times. Depend upon it, the day is not far distant when we shall find a certain acquaintance with electrical science as needful to us in our every-day work as a knowledge of building materials now is, or we shall find ourselves hopelessly at the mercy of the men whom we are obliged to employ. Holding this opinion, I would respectfully impress upon the Council of the Institute the desirability of acknowledging the claims of physical science and of requiring a certain amount of knowledge of it of the candidates for the Obligatory Examination that has recently been set on foot, and the results of which are already so promising. Science boasts of having captured the lightning, and she has done so, but it is not quite tamed yet, and let us beware of attempting to deal with the new servant ignorantly; it behoves us well to study its nature and advantages, to guard against the dangers connected with it, and to learn to use it, together with the older materials at our disposal, in accordance with our motto, "*Usui civium, Decori urbium.*"

Mr. J. L. SWAN.—I have had the pleasure, Mr. President, of listening to certainly one of the most complete and most lucid lectures on electric lighting that I have ever heard delivered.

Every portion of the ground has been traversed, and in most masterly style. The lecturer has suggested that perhaps I might make some addition to his own remarks with reference to the cost of electric lighting. I can do so to this extent. I can confirm the statement he made, that there is an essential economy in electric lighting. I speak more especially of electric lighting by incandescence, which I conceive to be the form of electric lighting which has the widest application open to it, and possesses the greatest interest for the public. I view the matter in this way. The comparison of cost must be instituted between *gas* and *electricity*, for gas light is really the light with which electric light will have to compete. If then we make a comparison between the cost of producing a certain amount of light by means of gas and by means of electricity, we arrive at something like the following result by a very simple and very radical process of calculation. Let us inquire what amount of light a certain quantity of coal will give us, on the one hand in the shape of gas light, and on the other hand in the form of electric light, the coal being in both cases applied in the best and most economical manner, and no account being taken in either case of incidental losses through leakage of pipes or resistance of conducting wires, or of defective methods of applying the two light producing agents. We find that if two cwt. of coal is carbonized in a gas retort, and turned into gas in the usual way, 1000 cubic feet of gas will be the result. This 1000 feet of gas will give us somewhere about 3000 candle light for an hour when burned under the ordinary condition, that is, when burned in ordinary burners, consuming about five feet of gas per hour which is giving the gas the most advantageous conditions for its burning—for, burned in smaller quantities, through burners which give less than sixteen candles light in one centre of light, so large an aggregate of light as 3000 candles would not be obtained. We may take it then that two cwt. of coal, turned into gas, will give us 3000 candle light for one hour. Now let us see what quantity of *electric light* this quantity of coal will produce through the medium of incandescent lamps. Motive power is, as you know, the foundation of electric lighting, and the steam engine is the form of motive power which we must consider in this comparison. I believe engineers will fully bear me out in saying that two cwt. of coal will, when economically applied through the best form of steam engine, develop 100 horse-power for one hour. Now it is a very moderate estimate, an estimate amply confirmed by a great number of trials, that at least 200 candle light can be obtained for each horse-power, so that the 100 horse-power which the two cwt. of coal would give us would be capable of producing, through the medium of incandescent lamps, 20,000 candle light, that is nearly seven times the amount of light which this quantity of coal would give us through the medium of gas. But it is necessary to take into account, in connection with the generation of gas, that gas is not the only product yielded by the carbonization of the coal. There are other products besides gas, of almost equal value to gas. I believe in the metropolitan gas works the amount obtained for the bye-products, produced in connection with the manufacture of gas, reduces the cost of the gas to the extent of one shilling a thousand cubic feet, or nearly by one-third. Let us make a more liberal allowance than this for the bye-products of the gas manufacture. Let us suppose that the products which are obtained along with gas are *half the value of the gas*, even then electric light has a very large advantage over gas light, even then the difference in favour of electric light would be as three and a half to one; and after other necessary deductions are made, I believe it will be fully as two to one. It is necessary to add that economy to this

extent is only possible on condition that the motive power is produced in the most economical manner; that is to say, in the manner in which it could be produced, if large electric lighting establishments were organized, and such establishments will arise when due facilities are given for the laying of electric wires in the streets; and I trust that the giving of these facilities may prove to be the outcome of the legislation, now under discussion by a committee of the House of Commons. I think it is of the last importance that due security should be given for the investment of capital in the creation of large electric lighting stations, for otherwise the public will be deprived of the benefit of a perfectly healthy and harmless illuminating agent which the electric light is. I think there is greater danger of the public being deprived of the advantages of the electric light altogether than of its interest being imperilled by the creation of monopolies—a supposed danger which has evidently been a ruling idea with the framers of the Electric Lighting Bill. In my opinion the real danger is that sufficient encouragement may not be given to the investment of capital for the extensive trial of electric lighting on a scale which will insure the obtaining of the most economical results. I count it a very great advantage that architects are giving attention to some of the details of electric lighting, and are considering the best arrangement of the lamps. The electrician will thus be helped by the architect in a very important point, and greatly aided in the carrying-out of a most desirable domestic illumination. I feel that our hands are quite full enough in dealing with the subject in its physical aspects, and that in connection with the decorative detail of the work we may leave it with the greatest satisfaction and confidence in the hands of members of the Royal Institute of British Architects.

Mr. ST. GEORGE LANE-FOX.—Mr. President, the lecturer has referred to the dangers of electric lighting. It is a mere myth to suppose that any danger will arise from the use of the electric light. I believe it is a monster conjured-up in the brain of the gas producer and the insurer, and that they wish to make the most of it. No doubt there have been certain unpleasant results from some improper installations. One or two people have been killed, perhaps, and a few places have been set on fire. But really it is just as possible to treat other things improperly, and cause damage thereby. If we light a fire in the middle of the room we cannot expect it to go on burning without doing damage; so it is with electrical matters. If we do not apply electricity properly there is likely to be danger. The dangers can be divided into two kinds, or under two heads, shocks and fire. Electric shock is due chiefly to high pressure in the electricity. It is necessary, however, that electricity should be driven to a very high state of tension, before any appreciable physiological effect is produced. When it is laid-on, as it will be very soon, in the streets, in the same way as gas and water, it will not be at a tension capable of producing a physiological effect at all. The lighting of this room at the present time is produced by electricity at a tension of some sixty units of electrical pressure, and I would not mind holding the wires in any part of the room, and guaranteeing not only that I should not receive a severe shock, but that I should not experience any shock at all. That is the form in which electricity will be applied. It is infinitely more practical and convenient to supply it at a low tension: it is then more easily divided, and in many ways more economical. In regard to the second question of danger from fire, that only arises from careless manipulation. I believe that in the earliest days of gas the leakage was about fifty per cent. of the total production. After a time they managed to reduce it thirty per

cent; and now I believe it is not more than three per cent. With electricity I think you can make a fair start with insulation on a much higher scale than the best insulation of gas. We have a knowledge of the subject specially derived from the telegraphs, &c., and the whole subject has been thoroughly thrashed-out, so that there is very little doubt on the matter in the minds of those who understand it. Many people however have still very little experience in the matter, and their ideas of insulation are certainly crude. The result has been that accidents have arisen. There is just one other point, and that is the question of storage batteries. It is rather a technical point. This matter has given rise to so much attention and interest, that I thought I might say a few words on the subject. Mr. Slater spoke of the action of these secondary batteries. He said that the current in passing through the liquid decomposed it, and transferred the oxygen to one set of plates, and the hydrogen to the other. I believe that to be an altogether erroneous notion. The facts, I think, are these. A secondary battery made with lead and a solution of sulphuric acid depends for its efficiency upon the plates of lead being coated or impregnated with oxide. A secondary battery is not really in existence until there is a certain extent of this oxide produced upon or in all the plates. The action of the battery in being charged is this. The current passes from one set of plates to the other, and the oxygen of one set is transferred to the other by electro-lytic action. The one set of plates is thus de-oxidized, and the other is per-oxidized. The capacity of these secondary cells depends on the extent or degree of oxidation which the battery admits of. This is of course a matter of a very technical nature, but as it is exciting very much attention, I thought I might mention it.

EDWARD I'ANSON, F.G.S., *Vice-President.*—I understood at the last meeting when this same subject was discussed that the electricity was produced from an engine. There is now no engine, and so I venture to ask, how is it conveyed here? [THE PRESIDENT.—In boxes.]

CHARLES FOWLER, *Fellow.*—Then I presume that if a person desires to give a brilliant party he can as readily order the requisite supply of electricity as he can order confectionery and the like.

THE PRESIDENT.—Certainly. There are one or two things that occurred to me during this excellent essay, and first of all Mr. Slater alluded to the Mansion House. I had the honour of attending a banquet there, and we had scarcely finished our soup when we were in total darkness. These things do occur sometimes in the early stages of the adaptation of new scientific appliances. With regard to Mr. Swan's estimates of the relative cost of electric lighting and gas lighting, I should not be prepared to give him a verdict entirely in favour of the economy of electric lighting without hearing the gas companies on the other side. I had to make some inquiries a little while ago, and from a very well known gentleman I was clearly informed that, to light a very large area some economy would be found on the side of electricity, but he intimated that he should be compelled, to obtain his economy, to use the arc light and not the incandescent, and that he considered the difference four to one in favour of the economy of the arc as compared with the incandescent. We are told, I think, that we are not to gild refined gold, to paint the lily or to add a perfume to the violet, but Mr. Slater has this evening illumined electricity.

C. FORSTER HAYWARD, F.S.A., *Fellow.*—I will take the opportunity of alluding to the experiment tried at Godalming mentioned in the Paper, as I know somewhat of the

successes there, as well as the difficulties and temporary failures. The origin of the idea with regard to the town of Godalming was the fact, that a quantity of waste water was continually running away from a certain mill, and the idea occurred to the owners of the mill themselves that this could be turned to advantage, not only to light their own factory, but also at the same time the streets of the town. There were several water-wheels, some of them not always in use, turned by the river Wey, which passes through the town and is liable to floods occasionally. One of these floods came directly after the electric lighting was commenced, and so there was a considerable failure at the outset—it is well to understand the failures as well as the successes of electric lighting. For several weeks the incandescent lights, to which I looked forward with great expectation and pleasure, gave no light at all, and everybody in the neighbourhood was calling out against them, so that there was great fear and great anxiety, on the part of those who were interested in the subject, lest the town should go back to the gas lighting, which was quite likely, for many of those who were most in favour of electricity were for giving it up entirely. At this juncture, I believe, Messrs. Siemens stepped in very opportunely, and rather than the whole subject of electricity should be put aside by such an experiment failing, they established steam power and have achieved a considerable success. Thus the lighting of the town by water power is given up, not that the water power itself failed to work, but simply from the circumstance that occasionally there was too much, and at other times not sufficient power in these water-wheels to do what was required; and occasionally they were liable to be over-worked by floods and other disturbing causes. For want of an accumulator of some kind for storing electricity—generated at convenient times—(such for instance as this battery which is here) no doubt the experiment failed which would otherwise have succeeded. Had there been a sufficiently developed form of reservoir to act as a gasometer acts, to regulate the pressure—or something like the Faure batteries, to keep up the supply—no doubt these water-wheels could have accumulated the electricity sufficiently during the time when they could work, so as to use the stored-up electricity in the town and elsewhere without any waste. Then I believe the success of working by water would have been established. As it happens, it is simply put aside for a time, till such apparatus is invented, and meanwhile I may say the success by the steam power is considerable, and works much more economically than gas. It is very satisfactory to me, as one living in the neighbourhood, to find that the experiment, though it did not succeed at first, was not allowed to fail and so throw a slur upon the system of electric lighting generally, but that it was able to be continued without resorting again to gas; so that Mr. Slater who has given us such an excessively good Paper was enabled to report favourably on it, as I understand he has done, from personal observation and inquiry. I am sorry to say the wires are not carried near enough to my own house, or I should have had the electric light in it many weeks ago.

JOHN SLATER, B.A.(Lond.), *Fellow.*—Under ordinary circumstances, Sir, anyone who should venture on two successive occasions, within little more than a year, to read Papers here on the same subject might, I think, not unjustly be accused of presumption, but the progress of the electric light has been so rapid, the novelties introduced have been so striking, and the general interest taken in the subject is of so exceptional a nature, that electric lighting stands almost in a category of its own. Hence, although I felt considerable diffidence in acceding to the request of the Council to read another Paper, I hoped I might be able to interest you.

But, Sir, I feel that very little thanks are due to me. If it had not been for the kindness of the gentlemen who have enabled me to show these lights in action, I should have had a very hard task, and my endeavours would have fallen very flat. I should have been like the theatrical manager who, having announced the play of "Hamlet" with a full caste, found himself on the evening of the performance obliged to read it, because his actors were not in a state to take their parts. Our thanks are particularly due to Mr. Sellon and Mr. Volckmar, who not only in the kindest way placed one of their batteries at my disposal, but who have gratuitously been at a great deal of trouble in fitting-up these wires to-night, and I think, Sir, that the Institute owes them a great debt of gratitude for showing what can be done by that battery, and by means of the incandescent lights. With regard to the arc lights being economical, there is no doubt that they are so; but it must be always borne in mind that although you get a greater amount of light per horse-power expended, yet in the immediate neighbourhood of the lamp itself, you get a great deal more light than is wanted, so that it may be more economical to use several small lights, rather than one large one, although the total amount of light obtained may be less. As to Godalming, Mr. Hayward has given precisely the facts. They tried water-power, but found it did not answer, and Messrs. Siemens Brothers took the matter up with very good results. The reason why some of the lamps now burning in this room are brighter than others is, that the resistance of the filaments varies. If the resistance of the filaments were precisely alike, the same current would work them to precisely the same amount of brightness. I have been asked to define the word "ohm," but it would take too long to explain fully what is meant by the term, and I must content myself with stating that it is the unit of electrical resistance.* With regard to water power: that can be used effectively, because Sir William Armstrong, at Newcastle, lights his picture gallery with electricity, worked by a turbine driven by a water-wheel in his own grounds, but you must get a certain fall to do it.

* The following are the principal units employed in electrical formulæ : (I.) The Volt which is the unit of electro-motive force or potential, and is as nearly as possible equal to the force of one Daniell cell. This being represented by 1, the volt is 0.9268. (II.) The Ampère (formerly called the Weber) which is the unit of current quantity, and is that quantity of electricity which would liberate .000158 grains of hydrogen per second. (III.) The Ohm which is the unit of resistance, and is about equal to the resistance of a telegraph wire, 4 millimètres in diameter and 100 mètres long, or to that of a column of pure quicksilver of one square millimètre sectional area, and about 41 inches long at a temperature of 0° Cent. These units are so related that an electro-motive force of one volt gives a current of one ampère through a resistance of one ohm. (IV.) the Farad—unit of capacity—and (V.) the Coulomb—unit of quantity—are not used in electric light calculations. Other electro-magnetic units were suggested by Dr. Siemens in his presidential address at the meeting of the British Association in August 1882, and it is probable that they will be eventually adopted by electricians generally, but at present those given above are the only ones in use." J. S.

APPENDICES TO MR. SLATER'S PAPER.

E.

ELECTRIC LIGHTING ACT, 1882.

An Act to facilitate and regulate the supply of Electricity for Lighting and other purposes in Great Britain and Ireland. [18th August, 1882.]

1. This Act may be cited for all purposes as the Electric Lighting Act, 1882.

2. The provisions of this Act shall apply to every local authority, company, or person who may by this Act or any license or provisional order granted under this Act, or by any special Act to be hereafter passed, be authorized to supply electricity within any area in this Act (referred to as "the undertakers") and to every undertaking so authorized, except so far as may be expressly provided by any such special Act; and every such license, provisional order, and special Act, is in this Act included in the expression "license-order, or special Act."

3. The Board of Trade may from time to time license any local authority as defined by this Act, or any company or person, to supply electricity under this Act for any public or private purposes within any area, subject to the following provisions :—

(1.) The consent of every local authority having jurisdiction within the area or any part of the area within which a supply is licensed to be furnished shall be required to the application for a license, which consent such local authority is hereby authorized to give, with such conditions (if any) as, subject to the approval of the Board of Trade, the local authority may prescribe :

(2.) A license shall be for any period not exceeding seven years, but may, at or after the expiration of such license, be renewed from time to time for a like period with such consent as above mentioned upon such terms and conditions as the Board of Trade may determine :

(3.) "Public purposes" shall mean lighting any street or any place belonging to or subject to the control of the local authority, or any church or registered place of public worship, or any hall or building belonging to or subject to the control of any public authority, or any public theatre, but shall not include any other purpose to which electricity may be applied :

(4.) "Private purposes" shall include any purposes whatever to which electricity may for the time being be applicable, not being public purposes, except the transmission of any telegram :

(5.) Every local authority, company, or person applying for a license shall publish notice of their application by public advertisement in such manner and including such particulars as the Board of Trade may from time to time direct or approve ; and such license shall not be granted by the Board of Trade until after the expiration of a period of three months from the date of the first publication of such advertisement, nor until opportunity has been given to all parties interested to make representations or objections to the Board of Trade with reference to the application :

(6.) No application for a license shall be made by any local authority except in pursuance of a resolution to be passed at a special meeting of the local authority, and such special meeting shall only be held after one month's previous notice of the same and of the purpose thereof has been given in the manner in which notices of meetings of such local authority are usually given :

(7.) A license may, subject to the provisions of this Act, be granted to a local authority authorizing them to supply electricity within any area although the same or some part thereof may not be included within their own district :

(8.) The license may make such regulations as to the limits within which and the conditions under which a supply of electricity is to be compulsory or permissive, and for enforcing the performance by the licensees of their duties in relation to such supply, and for the revocation of the license where the licensees fail to perform such duties, and generally may contain such regulations and conditions as the Board of Trade may think expedient :

(9.) Where in any area or part of an area in which any undertakers are authorized to supply electricity under any license the undertakers are not themselves the local authority, the license may contain any provisions and restrictions for enabling the local authority within whose jurisdiction such area or part of an area may be to exercise any of the powers of the undertakers under this Act with respect to the breaking up of any street repairable by such local authority within such area or part of an

area, and the alteration of the position of any pipes or wires being under such street, and not being the pipes or wires of the undertakers, on behalf and at the expense of the undertakers, and for limiting the powers and liabilities of the undertakers in relation thereto, which the Board of Trade may think expedient.

4. The Board of Trade may, from time to time, by provisional order authorize any local authority, company, or person to supply electricity for any public or private purposes within any area, without requiring such consents as are required to the granting a license under this Act, and for such period, whether limited or unlimited, as the Board of Trade may think proper, but in all other respects subject to the like provisions as in the last section contained with respect to licenses, and subject also to the following provisions :—

(1.) No provisional order shall authorize the supply of electricity by any undertakers within the district of any local authority (not being themselves the undertakers), unless notice that such provisional order has been or is intended to be applied for has been given to such local authority by the applicants in such manner as the Board of Trade may direct or approve on or before the first day of July in the year in which such application is made ; provided that in the case of any application made during the present year such notice shall be deemed to have been given in due time if the same is given within one month after the passing of this Act :

(2.) The Board of Trade may submit to Parliament for confirmation any provisional order granted by it in pursuance of this Act, but any such order shall be of no force unless and until it is confirmed by Act of Parliament :

(3.) If, while the Bill confirming any such order is pending in either House of Parliament, a petition is presented against any order comprised therein, the Bill so far as it relates to such order, may be referred to a Select Committee, and the petitioner shall be allowed to appear and oppose as in the case of private Bills :

(4.) Any Act confirming any provisional order granted in pursuance of this Act may, on the application of the undertakers thereby authorized to supply electricity, be repealed, altered, or amended by any subsequent provisional order granted by the Board of Trade and confirmed by Parliament.

5. The Board of Trade may from time to time make, and when made may rescind, alter, or repeal rules in relation to the applications for licenses or provisional orders, and to the payments to be made in respect thereof, and to the publication of notices and advertisements, and the manner in which and the time within which representations or objections with reference to any application are to be made, and to the holding of local inquiries in such cases as they may think it advisable, and to any other matters arising under this Act.

Any rules made in pursuance of this section shall be deemed to be within the powers conferred by this Act, and shall be of the same force as if enacted in this Act, and shall be judicially noticed.

Any rules made in pursuance of this section shall be laid before Parliament within three weeks after they are made if Parliament be then sitting, and if Parliament be not then sitting, within three weeks after the beginning of the next session of Parliament.

6. The undertakers shall be subject to such regulations and conditions as may be inserted in any license, order, or special Act affecting their undertaking with regard to the following matters :—

(*a.*) The limits within which and the conditions under which a supply of electricity is to be compulsory or permissive ;

(*b.*) The securing a regular and efficient supply of electricity ;

(*c.*) The securing the safety of the public from personal injury, or from fire or otherwise ;

(*d.*) The limitation of the prices to be charged in respect of the supply of electricity ;

(*e.*) The authorizing inspection and inquiry from time to time by the Board of Trade and the local authority ;

(*f.*) The enforcement of the due performance of the duties of the undertakers in relation to the supply of electricity by the imposition of penalties or otherwise, and the revocation of the license, order, or special Act where the undertakers have, in the opinion of the Board of Trade, practically failed to carry the powers granted to them into effect within a reasonable time, or discontinued the exercise of such powers ; and

(*g.*) Generally with regard to any other matters in connexion with the undertakings.

Provided always, that the Board of Trade may, from time to time, make such regulations as they may think expedient for securing the safety of the public from personal injury or from fire or otherwise, and may from time to time amend or repeal any regulations which may be contained in any such license, order, or special Act in relation thereto ; and any regulations so made or amended by the Board of Trade shall, from and after the date thereof, have the like effect in every respect as though they had been originally inserted in

the license, order, or special Act authorizing the undertaking, and every regulation so repealed shall, from and after the date thereof, be repealed accordingly, but such repeal shall not affect any liability or penalty incurred in respect thereof prior to the date of such repeal or any proceeding or remedy which might have been had in relation thereto.

Any local authority within any part of whose district electricity is authorized to be supplied under any license, order, or special Act may, in addition to any regulations which may be made under the preceding provisions of this section for securing the safety of the public, from time to time make, rescind, alter or repeal byelaws for further securing such safety; and there may be annexed to any breach of such byelaws such penalties to be recovered in a summary manner as they may think necessary: Provided always, that no such byelaws shall have any force or effect unless and until they have been confirmed by the Board of Trade and published in such manner as the Board of Trade may direct.

7. Any expenses incurred by a local authority under this Act, and not otherwise provided for, including any expenses incurred in connexion with the obtaining by them, or any opposition to the obtaining by any other local authority, company or person, of any license, order or special Act under this Act, may be defrayed out of the local rate as defined in the schedule to this Act, and the local authority may from time to time cause such rates to be levied as may be necessary for the purpose of defraying such expenses; provided that where such local authority is a rural sanitary authority such expenses shall be deemed to be special expenses within the meaning of the Public Health Act, 1875.

8. A local authority authorized to supply electricity by any license, order, or special Act may from time to time borrow money on such security, with such consent and subject to such provisions and restrictions with respect to borrowing and the repayment of loans, as are in the schedule to this Act in that behalf mentioned, and the money so borrowed shall be deemed to be borrowed under the enactments subject to the provisions and restrictions of which it is borrowed, and the accounts of all receipts and expenditure by the local authority in pursuance of this Act, or any license, order or special Act, shall be subject to such audit as is in the said schedule in that behalf mentioned: Provided always, that any moneys borrowed under this section by the local authority of any district to which the Local Loans Act, 1875, extends, may, if it is thought fit, be borrowed in manner provided by that Act; and in the construction of the said Act for the purposes of this Act the expression "prescribed" means prescribed by any conditions imposed by the authority whose consent is required to borrowing under this section.

Where any local authority is authorized by any Act to raise any money which they may be empowered to borrow for certain purposes by the issue of corporation or other stock, any money which a local authority may be authorized to borrow under this section may, if it is thought fit, be raised by them by the issue of such stock as aforesaid.

This section shall not apply to the mayor, commonalty, and citizens of the city of London or to the Metropolitan Board of Works, except in so far as the Metropolitan Board of Works may be concerned in the borrowing of any money by any vestry or district board.

9. The undertakers shall on or before the twenty-fifth day of March in every year fill up an annual statement of accounts of the undertaking made up to the thirty-first day of December then next preceding; and such statement shall be in such form and shall contain such particulars and shall be published in such manner as may from time to time be prescribed in that behalf by the Board of Trade.

The undertakers shall keep copies of such annual statement at their office, and sell the same to any applicant at a price not exceeding one shilling a copy.

In case the undertakers make default in complying with the provisions of this section, they shall be liable to a penalty not exceeding forty shillings for each day during which such default continues.

10. The undertakers may, subject to and in accordance with the provisions and restrictions of this Act, and of any rules made by the Board of Trade in pursuance of this Act, and of any license, order, or special Act authorizing or affecting their undertaking, and for the purpose of supplying electricity, acquire such lands by agreement, construct such works, acquire such licenses for the use of any patented or protected processes, inventions, machinery, apparatus, methods, materials, or other things, enter into such contracts, and generally do all such acts and things as may be necessary and incidental to such supply.

11. Any local authority who have obtained a license, order, or special Act for the supply of electricity, may contract with any company or person for the execution and maintenance of any works needed for the purposes of such supply, or for the supply of electricity within any area mentioned in such license, order, or special Act, or in any part of such area; but no local authority, company or person shall by any contract or assignment transfer to any other company or person or divest themselves of any legal powers given to them,

or any legal liabilities imposed on them by this Act, or by any license, order, or special Act, without the consent of the Board of Trade.

12. The provisions of the following Acts shall be incorporated with this Act; that is to say,

(1.) The Lands Clauses Acts, except the enactments with respect to the purchase and taking of lands otherwise than by agreement, and except the enactments with respect to the entry upon lands by the promoters of the undertaking; and

(2.) The provisions of the Gasworks Clauses Act, 1847, with respect to breaking up streets for the purpose of laying pipes, and with respect to waste or misuse of the gas or injury to the pipes and other works, except so much thereof as relates to the use of any burner other than such as has been provided or approved of by the undertakers; and

(3.) Sections thirty-eight to forty-two inclusive, and sections forty-five and forty-six, of the Gasworks Clauses Act, 1871.

For the purposes of this Act, in the construction of all the enactments incorporated by this section "the special Act" means this Act inclusive of any license, order, or special Act; and the "promoters" or "undertakers," and "the undertaking," as the case may be, mean the undertakers and the undertaking respectively under this Act.

In the construction of the said Lands Clauses Acts, "land" includes easements in or relating to lands.

In the construction of the said Gasworks Clauses Act, 1847, and the Gasworks Clauses Act, 1871, the said Acts shall be construed as if "gas" meant "electricity," and as if "pipe" meant electric line, and "works" meant works as defined by this Act, and as if "the limits of the special Act" meant the area within which the undertakers are authorized to supply electricity under any license, order, or special Act.

All offences, forfeitures, penalties, and damages under the said incorporated provisions of the said Acts or any of them may be prosecuted and may be recovered in manner by the said Acts respectively enacted in relation thereto, provided that sums recoverable under the provisions of section forty of the Gasworks Clauses Act, 1871, shall not be recovered as penalties, but may be recovered summarily as civil debts.

13. Nothing in this Act or in any Act incorporated therewith shall authorize or empower the undertakers to break up any street which is not repairable by such local authority, or any railway or tramway, without the consent of the authority, company or person by whom such street, railway or tramway is repairable, unless in pursuance of special powers in that behalf inserted in the license, order, or special Act, or with the written consent of the Board of Trade, and the Board of Trade shall not in any case insert any such special powers in any license or provisional order, or give any such consent until notice has been given to such authority, company, or person, by advertisement or otherwise, as the Board of Trade may direct, and an opportunity has been given to such authority, company, or person to state any objections they may have thereto.

14. Notwithstanding anything in this Act or in any Act incorporated therewith, the undertakers shall not be authorized to place any electric line above ground, along, over, or across any street, without the express consent of the local authority, and the local authority may require the undertakers to forthwith remove any electric line placed by them contrary to the provisions of this section, or may themselves remove the same, and recover the expenses of such removal from the undertakers in a summary manner; and where any electric line has been placed above ground by the undertakers in any position, a court of summary jurisdiction, upon complaint made, if they are of opinion that such electric line is or is likely to become dangerous to the public safety, may, notwithstanding any such consent as aforesaid, make an order directing and authorizing the removal of such electric line by such person and upon such terms as they may think fit.

15. Subject to the provisions of this Act and of the license, order, or special Act authorizing them to supply electricity, and to any byelaws made under this Act, the undertakers may alter the position of any pipes or wires being under any street or place authorized to be broken up by them which may interfere with the exercise of their powers under this Act, on previously making or securing such compensation to the owners of such pipes or wires, and on complying with such conditions as to the mode of making such alterations as may before the commencement of such alterations be agreed upon between the undertakers and owners, or in case of difference as may be determined in manner prescribed by the license or provisional order authorizing the undertakers to supply electricity, or where no such manner is prescribed as may be determined by arbitration, and any local or other public authority, company, or person may in like manner alter the position of any electric lines or works of the undertakers, being under any such street or place as aforesaid, which may interfere with the lawful exercise of any powers vested in such local or other public authority, company, or person in relation to such street or place, subject to the like provisions, conditions and restrictions as are in this section contained with reference to the alteration of the position of any pipes or wires by the undertakers.

16. If at any time after the undertakers have placed any works under, in, upon, over, along or across any canal, any person having power to construct docks, basins or other works upon any land adjoining to or near such canal, constructs any dock, basin or work on such land, but is prevented by the works of the undertakers from forming a communication for the convenient passage of vessels with or without masts between such dock, basin or other work, and such canal; or if the business of such dock, basin or other work is interfered with by reason or in consequence of any such works of the undertakers, then the undertakers at the request of such person, and on having reasonable facilities afforded them by him for placing works round such dock, basin or other work, under, in, upon, over, along or across land belonging to or under his control, shall remove and place their work accordingly. If any dispute arises between the undertakers and such person as to the facilities to be afforded to the undertakers, or as to the direction in which the works are to be placed, it shall be determined by arbitration.

17. In the exercise of the powers in relation to the execution of works given them under this Act, or any license, order, or special Act, the undertakers shall cause as little detriment and inconvenience and do as little damage as may be, and shall make full compensation to all bodies and persons interested for all damage sustained by them by reason or in consequence of the exercise of such powers, the amount and application of such compensation in case of difference to be determined by arbitration.

18. The undertakers shall not be entitled to prescribe any special form of lamp or burner to be used by any company or person, or in any way to control or interfere with the manner in which electricity supplied by them under this Act, and any license, order, or special Act is used: Provided always that no local authority, company, or person shall be at liberty to use any form of lamp or burner or to use the electricity supplied to them for any purposes, or to deal with it in any manner so as to unduly or improperly interfere with the supply of electricity supplied to any other local authority, company, or person by the undertakers, and if any dispute or difference arises between the undertakers and any local authority, company, or person entitled to be supplied with electricity under this Act, or any license, order, or special Act, as to the matters aforesaid, such dispute or difference shall be determined by arbitration.

19. Where a supply of electricity is provided in any part of an area for private purposes, then, except in so far as is otherwise provided by the terms of the license, order, or special Act authorizing such supply, every company or person within that part of the area shall, on application, be entitled to a supply on the same terms on which any other company or person in such part of the area is entitled under similar circumstances to a corresponding supply.

20. The undertakers shall not, in making any agreements for a supply of electricity, show any undue preference to any local authority, company, or person, but, save as aforesaid, they may make such charges for the supply of electricity, as may be agreed upon, not exceeding the limits of price imposed by or in pursuance of the license, order, or special Act authorizing them to supply electricity.

21. If any local authority, company, or person neglect to pay any charge for electricity or any other sum due from them to the undertakers in respect of the supply of electricity to such local authority, company, or person, the undertakers may cut off such supply, and for that purpose may cut or disconnect any electric line or other work through which electricity may be supplied, and may, until such charge or other sum, together with any expenses incurred by the undertakers in cutting off such supply of electricity as aforesaid, are fully paid, but no longer, discontinue the supply of electricity to such local authority, company, or person.

22. Any person who unlawfully and maliciously cuts or injures any electric line or work with intent to cut off any supply of electricity shall be guilty of felony, and be liable to be kept in penal servitude for any term not exceeding five years, or to be imprisoned with or without hard labour for any term not exceeding two years; but nothing in this section shall exempt a person from any proceeding for any offence which is punishable under any other provision of this Act, or under any other Act, or at common law, so that no person be punished twice for the same offence.

23. Any person who maliciously or fraudulently abstracts, causes to be wasted or diverted, consumes, or uses any electricity shall be guilty of simple larceny and punishable accordingly.

24. Any officer appointed by the undertakers may at all reasonable times enter any premises to which electricity is or has been supplied by the undertakers, in order to inspect the electric lines, meters, accumulators, fittings, works, and apparatus for the supply of electricity belonging to the undertakers, and for the purpose of ascertaining the quantity of electricity consumed or supplied, or where a supply of electricity is no longer required, or where the undertakers are authorized to take away and cut off the supply of electricity from any premises, for the purpose of removing any electric lines, accumulators, fittings, works, or apparatus belonging to the undertakers, repairing all damage caused by such entry, inspection, or removal.

25. Where any electric lines, meters, accumulators, fittings, works, or apparatus belonging to the undertakers are placed in or upon any premises not being in the possession of the undertakers for the purpose of supplying electricity under this Act, or any license, order, or special Act, such electric lines, meters, accumulators, fittings, works, or apparatus shall not be subject to distress or to the landlord's remedy for rent of the premises where the same may be, nor to be taken in execution under any process of a court of law or equity, or any proceedings in bankruptcy against the person in whose possession the same may be.

26. No alteration in any telegraph line of the Postmaster-General shall be made by the undertakers except subject to the provisions of the Telegraph Act, 1878.

The undertakers shall not in the exercise of the powers conferred by this Act, or by any license, order, or special Act, lay down any electric line or do any other work for the supply of electricity whereby any telegraph line of the Postmaster-General is or may be injuriously affected, and before any such electric line is laid down or work is done within ten yards of any part of a telegraphic line of the Postmaster-General (other than repairs or the laying of connexions with mains where the direction of the electric lines so laid down crosses the line of the Postmaster-General at right angles at the point of shortest distance and continues the same for a distance of six feet on each side of such point) the undertakers or their agents not more than twenty-eight nor less than seven clear days before commencing such work shall give written notice to the Postmaster-General specifying the course and nature of the work, including the gauge of any electric lines, and the undertakers and their agents shall conform with such reasonable requirements either general or special as may from time to time be made by the Postmaster-General for the purpose of preventing any telegraphs of the Postmaster-General from being injuriously affected by the said work.

Any difference which arises between the Postmaster-General and the undertakers or their agents with respect to any requirements so made, shall be determined by arbitration.

In the event of any contravention of or wilful non-compliance with this section by the undertakers or their agents the undertakers shall be liable to a fine not exceeding ten pounds for every day during which such contravention or non-compliance continues, or, if the telegraphic communication is wilfully interrupted, not exceeding fifty pounds for every day on which such interruption continues.

Provided that nothing in this section shall subject the undertakers or their agents to a fine under this section, if they satisfy the court having cognizance of the case that the immediate execution of the work was required to avoid an accident, or otherwise was a work of emergency, and that they forthwith served on the postmaster or sub-postmaster of the postal telegraph office nearest to the place where the work was done a notice of the execution thereof, stating the reason for executing the same without previous notice.

For the purposes of this section a telegraphic line of the Postmaster-General shall be deemed to be injuriously affected by a work if telegraphic communication by means of such line is, whether through induction or otherwise, in any manner affected by such work, or by any use made of such work.

For the purposes of this section, and subject as therein provided, sections, two, seven, eight, nine, ten, eleven, and twelve of the Telegraph Act, 1878, shall be deemed to be incorporated with this Act, as if the undertakers were undertakers within the meaning of those sections, without prejudice nevertheless to any operation which the other sections of the said Act would have had if this section had not been enacted.

27. Where any undertakers are authorized by a provisional order or special Act to supply electricity within any area, any local authority within whose jurisdiction such area or any part thereof is situated may, within six months after the expiration of a period of twenty-one years, or such shorter period as is specified in that behalf in the application for the provisional order or in the special Act, from the date of the passing of the Act confirming such provisional order, or of such special Act, and within six months after the expiration of every subsequent period of seven years, or such shorter period as is specified in that behalf in the application for the provisional order or in the special Act, by notice in writing require such undertakers to sell, and thereupon such undertakers shall sell to them their undertaking, or so much of the same as is within such jurisdiction, upon terms of paying the then value of all lands, buildings, works, materials, and plant of such undertakers suitable to and used by them for the purposes of their undertaking within such jurisdiction, such value to be in case of difference determined by arbitration : Provided that the value of such lands, buildings, works, materials, and plant shall be deemed to be their fair market value at the time of the purchase, due regard being had to the nature and then condition of such buildings, works, materials, and plant, and to the state of repair thereof, and the suitability of the same to the purposes of the undertaking, and, where a part only of the undertaking is purchased, to any loss occasioned by severance; but without any addition in respect of compulsory purchase or of goodwill or of any profits which may or might have been or be made from the undertaking, or of any similar considerations. The Board of Trade may determine any other questions which

may arise in relation to such purchase, and may fix the date from which such purchase is to take effect, and from and after the date so fixed, or such other date as may be agreed upon between the parties, all lands, buildings, works, materials, and plant so purchased as aforesaid shall vest in the local authority which has made the purchase, freed from any debts, mortgages, or similar obligations of such undertakers or attaching to the undertaking, and the powers of such undertakers in relation to the supply of electricity under this Act or such provisional order or special Act as aforesaid within such area or part thereof as aforesaid shall absolutely cease and determine, and shall vest in the local authority aforesaid.

28. Where any matter is by this Act, or any license, order, or special Act, directed to be determined by arbitration, such matter shall, except otherwise expressly provided, be determined by an engineer or other fit person to be nominated as arbitrator by the Board of Trade on the application of either party, and the expenses of the arbitration shall be borne and paid as the arbitrator directs.

Any license or provisional order granted under this Act shall be deemed to be a special Act within the meaning of the Board of Trade Arbitrations, &c., Act, 1874.

29. Where a supply of electricity is authorized in any area by any license, order, or special Act, and a supply of gas by any gas undertakers is also authorized within such area or any part thereof by any provisional order or special Act under the provisions of which such gas undertakers are under any general or limited obligation to supply gas upon demand, the Board of Trade may, upon the application of such gas undertakers, inquire into the circumstances of the case, and if they are satisfied that any specified part of such area is sufficiently supplied with electric light, and that the supply of gas in such specified part has ceased to be remunerative to the gas undertakers, and it is just that such gas undertakers should be relieved from the obligation to supply gas upon demand as aforesaid, the Board of Trade may in their discretion make an order relieving the gas undertakers from such obligation, within such specified part of such area, either wholly or in part, and upon such terms and conditions as they may think proper; and from and after the date of such order such gas undertakers shall be so relieved accordingly. All expenses of the Board of Trade in connexion with any such inquiry or order shall be borne and paid by the gas undertakers upon whose application the inquiry or order was made.

30. Not later than the first day of July in each year the Board of Trade shall lay before both Houses of Parliament a report respecting the applications to and proceedings of the Board of Trade under this Act during the year then last past.

31. In this Act, unless the context otherwise requires, the expressions "local authority" and "local rate" mean, as respects each district set forth in the first column of the schedule to this Act annexed, the authority and rate mentioned opposite to that district in the second and third columns of that schedule; and such schedule, and the notes appended thereto, shall be of the same validity as if enacted in the body of the Act.

32. In this Act, unless the context otherwise requires—

The expression "electricity" means electricity, electric current, or any like agency:

The expression "electric line" means a wire or wires, conductor, or other means used for the purpose of conveying, transmitting, or distributing electricity with any casing, coating, covering, tube, pipe, or insulator enclosing, surrounding, or supporting the same, or any part thereof, or any apparatus connected therewith for the purpose of conveying, transmitting, or distributing electricity or electric currents:

The expression "works" means and includes electric lines, also any buildings, machinery, engines, works, matters, or things of whatever description required to supply electricity and to carry into effect the object of the undertakers under this Act:

The expression "company" means any body of persons corporate or unincorporate:

The expression "Lands Clauses Acts" means the Lands Clauses Consolidation Acts, 1845, 1860, and 1869:

The expression "street" includes any square, court, or alley, highway, lane, road, thoroughfare, or public passage, or place, within the area in which the undertakers are authorized to supply electricity by this Act or any license, order, or special Act:

The expression "telegram" has the same meaning as in the Telegraph Act, 1869.

33. Nothing in this Act shall limit or interfere with the rights of any owner, lessee, or occupier of any mines or minerals lying under or adjacent to any road along or across which any electric line shall be laid to work such mines and minerals.

34. Nothing in this Act shall exempt the undertakers or their undertaking from the provisions of any general Act relating to the supply of electricity which may be passed in this or any future session of Parliament.

35. Nothing in this Act or in any license, order, or special Act, shall affect the exclusive privileges

conferred upon the Postmaster-General by the Telegraph Act, 1869, or authorize or enable any local authority, company or person to transmit any telegram or to perform any of the incidental services of receiving, collecting, or delivering telegrams, or give to any local authority, company, or person, any power, authority, or facility of any kind whatever, in connexion with the transmission of telegrams, or the performance of any of the incidental services of receiving, collecting, or delivering telegrams.

As to Scotland.

36. This Act shall apply to Scotland with the following modifications:

The expression "Lands Clauses Acts" means the Lands Clauses Consolidation (Scotland) Acts, 1845 and 1860.

The expression "simple larceny" means theft.

The expression "felony" means a high crime and offence.

The expression "public purposes" means lighting any street or any place belonging to or subject to the control of any public authority, or any church or place of public worship, or any hall or building belonging to or subject to the control of any public authority, or any public theatre, but shall not include any other purpose to which electricity may be applied.

The expression "local authority" means as regards streets and roads the authority having the control of the streets and roads.

As to Ireland.

37. This Act shall apply to Ireland with the following modifications:

Where the consent of the grand jury of any county to the breaking up of any road is required under this Act, such consent may be signified by the county surveyor; and where it is required under this Act that notice should be given by the Board of Trade to the grand jury of any county, and an opportunity afforded to such grand jury to state objections, such notice may be given to, and such objections may be stated by, the county surveyor on behalf of the grand jury:

The expression "Public Health Act, 1875," means the Public Health (Ireland) Act, 1878.

F.

RULES MADE BY THE BOARD OF TRADE (AUGUST, 1882) WITH RESPECT TO APPLICATIONS FOR LICENSES AND PROVISIONAL ORDERS, &c.

Rule I.—No application for a license or for the renewal of a license can be entertained unless proof of the consent of the local authority to such application is given to the Board of Trade.

Rule II.—When applications for provisional orders authorizing the supply of electricity within the district of any local authority are received by the Board of Trade for such local authority, and also from any other authority, company, or person, the Board of Trade will give a preference to the application of the local authority of the district in every case where, in the opinion of the Board of Trade, no special circumstances exist which render such a preference inexpedient.

Application and Deposit.

Rule III.—Every application for a license or Provisional Order must be made by memorial signed by, or on behalf of, the applicants, headed with a short title descriptive of the proposed undertaking (corresponding with that at the head of the advertisement hereinafter mentioned) addressed to the Board of Trade, and praying for a license or Provisional Order. With the memorial must be deposited six copies of the license or order, as proposed by the applicants, with the schedule or schedules (if any) referred to therein.

Rule IV.—The deposited copies of the proposed license or order must be in print. They must be printed on one side only of the page of paper, so as to leave the back of the page blank, and each schedule annexed must begin a new page.

The names and addresses of the parliamentary agents or solicitors for the license or order must be printed on the outside of the draft.

There must be a notice at the end of the draft, stating that objections are to be made by letter addressed to the Board of Trade, marked on the outside of the cover enclosing it "Electric Lighting Act," and this letter

is to be sent to the Board of Trade within two months from the date of the newspaper containing the first advertisement of the application. The draft must contain amongst other things—

1. Address and description of the applicants.
2. A description of the proposed area of supply.
3. A statement of the purposes for which a supply is to be given, viz., any or all of the public or private purposes specified in section *three* of the Act.
4. A general description of the proposed works.
5. Provisions concerning the breaking up of streets not repairable by a local authority and concerning interference with railways and tramways, where powers are sought to be obtained by the license or order for those purposes.
6. Conditions of supply, including price, nature and amount of supply, obligation to supply, &c.
7. Period for which concession is sought.
8. Provisions for securing the safety of the consumer and of the public from injury by shock, fire, or otherwise.
9. Provisions for enforcing the performance by the undertakers of their duties in relation to the supply of electricity and for the revocation of the license or order where the undertakers fail to perform such duties.

The applicants are also to deposit a sufficient number of such printed drafts at offices in London and within the proposed area of supply to be specified in the advertisement, such copies to be there furnished to all persons applying for them, at a price of not more than one shilling each.

Rule V.—There must also be deposited with the memorial,—a published map of the district on a scale of not less than one inch to a mile, or if there is no published map, then the best map procurable showing the boundaries of the proposed area of supply, the lands which the applicants propose to take for the purposes of the license or order, and the streets and other places in, over, or along which it is proposed to place any electric lines or other works. A copy of the said map is also to be deposited for public inspection in England or Ireland, in the office of the clerk of the peace for every county, riding or division, and of the local authority of every district; in Scotland in the office of the principal sheriff clerk, for every county, district or division, and of the local authority of every district in which the proposed area of supply or any part thereof is situate.

Rule VI.—There must also be deposited with the memorial,—

1. A list of the local authorities in whose districts the area of supply is situate.

2. A list of the streets not repairable by a local authority and of the railways and tramways (if any) which the applicants propose to take powers to break up.

3. A list of the canals and navigable rivers (if any) which the undertakers will be empowered under the license or order to cross.

4. A statement of the capital proposed to be expended and employed in connexion with the undertaking, and the mode in which such capital is to be provided.

5. If the applicants are a company incorporated under the provisions of the Companies' Acts, a copy of the memorandum and articles of association.

6. A fee of £50 by cheque payable to an "Assistant Secretary of the Board of Trade" to cover ordinary expenses. If in consequence of inquiries or otherwise additional expense is incurred, the amount will be charged to the applicants and must be paid by them in addition to the ordinary fee.

7. Where the undertakers under any license, order, or Special Act desire the consent of the Board of Trade to enable them to break up any street not repairable by a local authority or any railway or tramway which they are not empowered to break up under such license, order, or Special Act, the memorial must specially request such consent and must describe accurately the street, railway, or tramway which they propose to acquire power to break up.

Rule VII.—Where the approval or consent of any local authority is required to any application for a license or order, such approval or consent must be given by a resolution passed at a special meeting of the local authority held after one month's previous notice of the same, and of the purpose thereof, has been given in the manner in which notices of meetings of such local authority are usually given, and the fact that such a resolution was duly passed must be proved by furnishing a certificate signed by the secretary or clerk to such local authority embodying copies of the notice and of the resolution, and certifying that the notice was duly given and the resolution duly passed.

Rule VIII.—In any case where a local authority, company, or person is required by the Act to give notice to the local authority of the district, "in such a manner as the Board of Trade may direct or approve," such

notice shall be given in writing, and shall be served, either by leaving the same at the offices of the said local authority on or before the appointed day or by forwarding the same by post in a registered letter so that the same would in ordinary course of post be delivered on or before the appointed day.

Procedure where Application is entertained.

Rule IX.—If the application is entertained by the Board of Trade, the applicants must proceed as follows: —They shall publish notice by advertisement that such application has been made. Every advertisement shall contain the following particulars :—

1. The objects of the application.
2. Address and description of applicants.
3. A general description of the nature of the proposed works.
4. A description of the proposed area of supply.
5. The names of the streets and other places in, over, or along which it is proposed to place any electric lines or other works.
6. A list of the streets not repairable by a local authority and of the railways and tramways (if any) which the applicants propose to take powers by the license or order to break up.
7. A list of the canals and navigable rivers which the undertakers will be empowered under the license or order to cross.
8. An office in London, and another office within the proposed area of supply, at which printed copies of the draft license or order when applied for, and of the license or order when made, can be obtained at a price of not more than one shilling each. The advertisement is to be headed with a short title, descriptive of the undertaking (corresponding with that at the head of the memorial), and it must state that every local or other public authority, company, or person desirous of making any representation to the Board of Trade, or of bringing before them any objection respecting the application, may do so by letter addressed to the Board of Trade, marked on the outside of the cover enclosing it "Electric Lighting Act," within two months from the date of the newspaper containing the first advertisement. The advertisement is to be inserted, once at least in each of two successive weeks in one and the same newspaper, published and circulating in the proposed area of supply, or in such other newspaper as the Board of Trade may direct; and once at least in the London, Edinburgh, or Dublin Gazette, accordingly, as the proposed area of supply is situate in England, Scotland, or Ireland.

Rule X.—In all cases of applications for a license, renewal of license, or provisional order, to which objection is made by any person locally interested, the Board of Trade will, if either the applicants or the objectors so desire, hold a local inquiry of which due notice will be given.

Rule XI.—If any local or other public authority, company, or person, desires to have any clauses or other amendments inserted in the license or order, they must deliver the same to the parliamentary agents or solicitors for the order, and also to the Board of Trade on or before the time limited for bringing objections.

Rule XII.—When a license or provisional order is ready, and before the same is delivered, the applicants must deposit at the office of the Board of Trade a description of the lands (if any) which they propose to purchase for the purposes of the license or provisional order, and must produce to the Board of Trade the contracts for the purchase of all such lands.

Rule XIII.—When a license or provisional order has been made by the Board of Trade and delivered to the applicants, they shall forthwith deposit printed copies for public inspection in the offices specified in Rule V., and shall supply copies to all persons applying for the same, and shall further publish the same as the Board of Trade may direct.

Special Provisions as to Provisional Orders.

Rule XIV.—In the case of provisional orders the following additional regulations must be observed.

1. The advertisements must be inserted in *October* or *November*.
2. A copy of the advertisement and map must be deposited *on or before* the 30*th November* in the offices specified in Rule V., and at the Board of Trade.
3. The memorial must be lodged on or before 21*st December*.
4. The parliamentary agents or solicitors for the order must be prepared to prove compliance with the provisions of the Act and these rules by the 25th of January and all such proofs must be completed on or before the 25th February. Six days' notice will be given of the day and hour at which such agents or solicitors are to attend for the purpose at the Board of Trade, and printed forms of proof will accompany the notice. These forms should be filled up and brought with the requisite documents to the Board of Trade at the time fixed for receiving proof.

G.

FIRE RISK AND ELECTRIC LIGHT.

The following Letter, addressed to the Editor of *The Times*, was published in that newspaper on the 10th May, 1882 :—

SIR,—Various conflicting statements have from time to time been put forward as to electric light and fire risk. On the one hand, it has been said that the use of electric light guarantees absolute safety from fire; and, on the other hand, the fact that no less than six fires occurred in the recent Paris Exhibition has caused certain fire offices to actually charge an increased premium when electric light is substituted for gas. We, in common, we think, with other electric-light engineers, believe that electric light is absolutely safe if certain definite and well-understood rules are observed in arranging the installations, but that, like every other kind of power, whether steam, gas, water or animal, it will be a fruitful source of danger if the arrangements are intrusted to ignorant or unskilful hands. When two wires become accidentally connected they sometimes are heated to redness by currents which pass through the wires only, instead of through lamps. It appears to us that the subject is one of great importance, as, on the one hand, if the installations are made unskilfully, fires will occur, while, on the other, if through blunders in early installations enough fires are caused to alarm the insurance offices, electric-light enterprise will be seriously hampered by the heavy premiums which will be charged. The Phœnix, one of the oldest and largest of our fire insurance offices, have investigated the matter, and as a result have received an admirable report from their engineer, Mr. Musgrave Heaphy, C.E. The report concludes as follows: "And now with reference to the question as to whether the electric light, taken as a whole, is safer or more hazardous than gas; I am of opinion—so far as conclusions can be drawn from the present knowledge of the subject—that where systematic and proper precautions are taken there is less danger from electric lighting than from gas; but that if carelessly or ignorantly arranged, or improperly worked, then serious fires may be apprehended." Mr. Heaphy then gives the following rules, the observance of which will, we understand, be required by the Phœnix on insuring electrically-lighted buildings. We may add that at a recent meeting representing the principal electric-light companies these rules met with general approval. These rules are primarily intended for observance in mills, theatres and generally that class of buildings technically known as "hazardous risks." It would, however, in our opinion, be well that their adoption should be everywhere insisted on by the fire offices, as it must be remembered that electricity is now supplied on a very small scale, but that in a very short time it will be supplied on at least as large a scale as gas or water. Apologising for the length of this letter, we remain, Sir, your obedient servants,

(*Signed*) R. E. CROMPTON, M.S.T.E.
J. E. H. GORDON, M.S.T.E.

PHŒNIX (FIRE INSURANCE OFFICE) RULES FOR ELECTRIC LIGHT INSTALLATIONS.

"1. All rods or wires in a building to be so placed as to be thoroughly and easily inspected.

"2. All rods and wires to have sufficient sectional area, so as to allow at least 50 per cent. more electricity being safely sent through them than will ever possibly be required for the lights they supply.

"3. All main rods (or wires) should be thoroughly well insulated with a material rendered as non-inflammable as possible, and further protected by coverings of a substantial and durable character. Wherever practicable, the rod (or wires) should be enclosed in iron, brass, lead, terra-cotta or earthenware pipes, the space between the rod (or wires) and the pipe being completely filled with a high insulating compound. Or the rods (or wires) should be thoroughly well insulated with a material as non-inflammable as possible, and might be placed in slate beading or slate boxes. To be approved by the inspector from the fire office.

"4. The wires for 'arc lights' to be insulated and protected in the same manner as the aforesaid main rods or wires. The wires, unless enclosed in pipes or slate boxes, &c., as described under requirements No. 3, should be laid at least 8 inches from each other, and 8 inches from all other wires, metal or conducting substances. Or where this from the nature of the case is impossible, then the wires must be kept at least 1 inch apart, and 1 inch from all conducting substances by a continuous rigid non-conducting material, to be approved by the inspector from the fire office.

"5. The wires for the incandescent lights should be at least 2½ inches from each other, and 2½ inches at least from all other wires, metal or other conducting substances; they must be thoroughly well insulated with a material rendered as non-inflammable as possible, and protected by coverings of a substantial and durable character; and where external injury is possible they should be insulated and enclosed in iron, lead, brass,

terra-cotta or earthenware pipes, or in slate beading or slate boxes, in the manner described in requirements No. 3 for the main rods.

("In non-hazardous risks the wires, having been thoroughly well insulated with a material rendered as non-inflammable as possible, should, where practicable, be enclosed in wood beading, and the wires kept apart by a continuous fillet of wood at least 1 inch wide.)

"6. All rods or wires passing through floors or partitions must be insulated, and inclosed in iron, brass, terra-cotta or earthenware pipes, or slate beading, in the manner described under requirements No. 3.

"7. All rods or wires passing through the exterior walls of buildings must be insulated and inclosed in pipes as described in requirements No. 3, and the insulated material must be impervious to moisture.

"8. All rods or wires in a building that are exposed to moisture must have a waterproof covering to their insulating material.

"9. The fastenings of all rods or wires to be composed of an approved non-conducting material.

"10. Any material employed for conducting the electricity in lieu of rods or wires must be protected in the same manner as the before-mentioned rods or wires.

"11. All lamps, switches, or any bare connexions must be so mounted that leakage of electricity from them is rendered impossible.

"12. When two wires are joined together, the junction must be soldered, or secured by a thoroughly clean binding screw or clamp.

"13. Wherever a branch wire is led off the main conductor to supply current for one or more incandescent lamps, a short length of lead or other fusible wire must be inserted between the main conductor and one end of the branch; and the lead wire must be of such section and nature that if the current passing through it exceeds the normal current by 50 per cent., then it will fuse and disconnect the branch.

"14. No naked lights allowed. If 'arc lights' are used, the globes must be inclosed at the base, and have chimneys so arranged that no sparks or flame can escape. The globes must also be covered round with wire netting.

"15. All 'connexions,' 'cut-outs,' or 'resistance coils' must be placed in such a secure manner that no danger can arise in the event of their heating.

"16. A shut-off must be placed at the point of entrance to each building.

"17. No ground circuit allowed.

"18. All work is to be of a substantial character, and put up in a thorough workmanlike manner, and to be accurately tested at the time of erection for insulation.

"19. When the 'electric light' is intended to be used, information must be supplied of the particular system of lighting that is to be adopted; how and where the electricity is to be generated; the number and kind of lamps used; the quantity of electricity to be conveyed through the wires; the conductive capacity of the wires; method of insulation; whether there is to be metallic circuit; and as far as possible full details of the manner in which it is proposed to equip the building. "Musgrave Heaphy, C.E.

"Phœnix Fire Office, February-April, 1882."

H.

The Council of the Society of Telegraph Engineers and of Electricians have drawn-up (21st June, 1882) the following Rules and Regulations for the prevention of Fire risks arising from Electric Lighting, and for the guidance and instruction of those who have Electric Lighting apparatus installed on their premises, namely:—

I. The Dynamo Machine.

1. The dynamo machine should be fixed in a dry place.
2. It should not be exposed to dust or flyings.
3. It should be kept perfectly clean and its bearings well oiled.
4. The insulation of its coils and conductors should be perfect.
5. It is better, when practicable, to fix it on an insulating bed.
6. All conductors in the dynamo room should be firmly supported, well insulated, conveniently arranged for inspection, and marked or numbered.

II. The Wires.

7. Every switch or commutator used for turning the current on or off should be constructed so that when it is moved and left to itself it cannot permit of a permanent arc or of heating, and its stand should be made of slate, stoneware or some other incombustible substance.

8. There should be in connexion with the main circuit a safety fuse constructed of easily fusible metal which would be melted if the current attain any undue magnitude, and would thus cause the circuit to be broken.

9. Every part of the circuit should be so determined, that the gauge of wire to be used is properly proportioned to the currents it will have to carry, and changes of circuit from a larger to a smaller conductor, should be sufficiently protected with suitable safety fuses so that no portion of the conductor should ever be allowed to attain a temperature exceeding 150° F.

N.B.—These fuses are of the very essence of safety. They should always be enclosed in combustible cases. Even if wires become perceptibly warmed by the ordinary current, it is a proof that they are too small for the work they have to do, and that they ought to be replaced by larger wires.

10. Under ordinary circumstances complete metallic circuits should be used, and the employment of gas or water pipes as conductors for the purpose of completing the circuit should in no case be allowed.

11. Where bare wire out of doors rests on insulating supports it should be coated with insulating material, such as india-rubber tape or tube, for at least 2 feet on each side of the support.

12. Bare wires passing over the tops of houses should never be less than 7 feet clear of any part of the roof, and they should invariably be high enough, when crossing thoroughfares, to allow fire-escapes to pass under them.

13. It is most essential that the joints should be electrically and mechanically perfect.

14. The position of wires, when underground, should be efficiently indicated, and they should be laid down so as to be easily inspected and repaired.

15. All wires used for indoor purposes should be efficiently insulated.

16. When these wires pass through roofs, floors, walls or partitions, or where they cross or are liable to touch metallic masses, like iron girders or pipes, they should be thoroughly protected from abrasion with each other, or with the metallic masses, by suitable additional covering; and where they are liable to abrasion from any cause, or to the depredations of rats or mice, they should be efficiently encased in some hard material.

17. Where wires are put out of sight, as beneath flooring, they should be thoroughly protected from mechanical injury, and their position should be indicated.

N.B.—The value of frequently testing the wires cannot be too strongly urged. It is an operation skill in which is easily acquired and applied. The escape of electricity cannot be detected by the sense of smell, as can gas, but it can be detected by apparatus far more certain and delicate. Leakage not only means waste, but in the presence of moisture it means destruction of the conductor and its insulating covering, by electric action.

III. Lamps.

18. Arc lamps should always be guarded by proper lanterns to prevent danger from falling incandescent pieces of carbon, and from ascending sparks. Their globes should be protected with wire netting.

19. The lanterns, and all parts which are to be handled, should be insulated from the circuit.

IV. Danger to Person.

20. To secure persons from danger inside buildings, it is essential so to arrange the conductors and fittings that no one can be exposed to the shocks of alternating currents exceeding 60 volts; and that there should never be a difference of potential of more than 200 volts between any two points in the same room.

21. If the difference of potential within any house exceeds 200 volts, whether the source of electricity be external or internal, the house should be provided outside with a "switch," so arranged that the supply of electricity can be at once cut off.

X. PRESENTATION OF THE ROYAL GOLD MEDAL, 1882,

To Baron von Ferstel, *Hon. & Corr. Member* (Vienna).

[Presented on Monday, 5th June, 1882, Horace Jones, *President*, in the Chair.]

THE PRESIDENT.—Gentlemen,—It is now thirty-five years ago since Her most Gracious Majesty, modifying the original terms of the gift, was pleased to command a Royal Medal to be confided to us for the purpose of annually awarding it to some eminent person, architect or man of science, engaged in aiding and promoting the study and practice of architecture, and to-night we meet to present it to the thirty-fifth recipient. This Royal Medal, Gentlemen, has been widely distributed, and it has by no means been confined to the subjects of Her Majesty: indeed, I find that there have been six French gentlemen, three German gentlemen, one Austrian and one Italian gentleman, to whom it has been given at different periods, and that there are at present living only six English architects who possess it. Of the foreigners—eleven in number—four medals, as I have mentioned, have fallen to the honour of the German nations, and to-night we shall have the pleasure of handing to the representative of the fifth—Baron von Ferstel, of Vienna—the Medal for this year. The four distinguished men who preceded the Baron were the late Chevalier von Klenze, who did so much and such admirable work in Munich; the late August Stüler, who practised in Berlin, and whose works many of us know; Herr Lepsius, the celebrated author and archæologist; and Professor Schmidt, of Vienna. I may add that these gentlemen, whose works we all admire, will have their reputation in no degree diminished, in the eyes of the world, by having the name of von Ferstel added to their number. I regret that he is unable to be in England at this time; it is always a pleasure to see and know architects and colleagues who have distinguished themselves so worthily and so much as Baron von Ferstel; it is a pleasure to see their bodily presentment and faces, an honour to us to grasp their hands in friendly and honest admiration of their character and in recognition of their worth. Though I should have desired to have done this personally, I nevertheless have very great pleasure in handing to Baron Wacken, the Secretary to the Austro-Hungarian Embassy in London, here present on behalf of his distinguished countryman, the Royal Gold Medal for the year 1882, the gift of the Queen to Baron von Ferstel, to whom we all wish health, long life and happiness.

Baron WACKEN.—Messieurs, c'est par un heureux hasard que j'ai été chargé au dernier moment de l'honorable mission de représenter mon compatriote distingué à cette assemblée solennelle; je me trouve sans instructions de sa part et je ne puis que deviner les sentiments qui l'animent aujourd'hui, qui l'animeraient surtout, s'il lui était permis de se trouver parmis vous. En premier lieu c'est indubitablement le sentiment d'une profonde gratitude pour l'insigne honneur que vous avez bien voulu lui conférer aujourd'hui, honneur d'autant plus marquant que personne plus que vous, Messieurs, n'est à même de prononcer un jugement compétent sur ses mérites; pourtant ce sentiment de gratitude doit nécessairement être mélangé de celui du regret de ne pouvoir assister en personne à cette cérémonie, d'autant plus que, comme je viens de l'apprendre, le Baron de Ferstel n'a encore jamais visité l'Angleterre et

ne connaît qu'en théorie les nombreux monuments anciens et modernes qui forment à si juste titre une des gloires de votre belle patrie. Soyez pourtant persuadés, Messieurs, que malgré les obstacles géographiques, qui forment encore toujours une barrière entre l'Angleterre et le Continent, l'importance des créations du génie anglais est pleinement reconnu chez nous; aussi le témoignage honorifique que vous venez d'accorder à Monsieur de Ferstel sera-t-il, comme toutes les marques d'approbation qui nous proviennent de l'Angleterre, apprécié à sa juste valeur en Autriche et en Allemagne, où l'Angleterre, après avoir été l'école à laquelle nous avons développé nos libertés politiques, continue être considérée comme l'école des progrès matériels par excellence. C'est à elle que nous devons toutes ces grandes inventions techniques qui en peu d'années ont opéré les changements matériels que nous sommes heureux de constater aujourd'hui, et c'est toujours encore vers elle que nous nous tournons les yeux toutes les fois qu'il s'agit du perfectionnement de nos chemins-de-fer, machines et autres appareils techniques. Vous connaissez mieux que moi, Messieurs, l'importance que toutes ces inventions ont eue pour le coté technique de l'Architecture, je ne me permettrai donc guère d'entrer dans des détails sur des questions aussi scientifiques, tout à fait hors de ma partie; pour une raison analogue je m'abstiendrai d'une comparaison artistique de l'architecture monumentale en Angleterre et en Autriche. Permettez moi pourtant, Messieurs, de vous dire un mot sur un point qui m'a le plus frappé en visitant les différents édifices de Londres et de la province. Je veux parler de l'Architecture pratique anglaise, du nombre et du caractère de ses édifices publics, de ses hôpitaux, halles et marchés, ses gares de chemins-de-fer et autres établissements. Ce que j'y admire, c'est la manière dont les exigences décoratives sont savamment unies à une conception simple et pratique, un luxe solide, à une distribution ingénieuse, en un mot, la manière dont le génie pratique du peuple anglais se manifeste dans ces établissements d'utilité publique, et je crois que sous ce rapport nous aurions encore beaucoup à apprendre chez nous. Pour terminer, Messieurs, je ne saurais mieux interpréter l'expression de reconnaissance de mon compatriote qu'en rappelant à votre souvenir que c'est Sa Majesté la Reine, l'auguste Souveraine de ce Royaume, qui a gracieusement appelé le Baron de Ferstel à l' honneur dont il est aujourd'hui l'objet, c'est avant tout à Elle que s'adressent ses très respectueux remerciments pour une distinction à laquelle la volonté de la Couronne ajoute autant de valeur. Mais Sa Majesté s'est laissée guider dans sa décision par les conseils éclairés et impartiaux de cette Société scientifique. C'est donc à vous, Messieurs, qui êtes en même temps les collègues et les juges de M. de Ferstel que je dois adresser collectivement et individuellement à chacun de vous ses remerciments pour une marque aussi flatteuse de votre estime; elle offre une nouvelle garantie pour le reserrement des liens qui unissent le progrès scientifique du Continent à celui de l'Angleterre, et je crois agir dans les intentions de M. de Ferstel en souhaitant à votre Société une prospérité toujours croissante qui lui permette de continuer l'importante mission d'une protectrice des arts et de la science. Vivat, floreat et crescat!